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MANUAL CONCEPTS: A STUDY OF THE INFLUENCE OF HAND-USAGE ON CULTURE-GROWTH.

BY FRANK HAMILTON CUSHING.

INTRODUCTORY.

Steps toward man's intellectual development.—If we assume that there have been three great steps in the intellectual development of man, the biotic, the manual, and the mental—

(*a*) *The biotic.*—Then, during his biotic development, man, as a genus of animal species merely, had progressed so far as to have free hands. Though these may have been developed in climbing, yet he had not now either to creep or to climb, but could walk erect; could fend and defend freely with these hands.

(*b*) *The manual.*—It was then that man began to develop extra-naturally; no longer like the mere animal, by coercion of the direct forces of natural environment, but rather by making an environment of his own, and this, first, by means of his hands—that is to say, this experience in warding off the blows of nature with his hands gave rise to devising, in which is to be sought the beginning of formal mentation—that is, of conscious ratiocination, as compared to instinctive consciousness and volition. Therefore I have named this period of man's development from his ancestral animal species, both physically and mentally, the manual.

(*c*) *The mental.*—No one has better defined the next period of man's development than our true-seeing teacher, Major Powell, when he states that the mental step or stage depends on the ascer-

tainment of *truth*. The degree to which man, practically, intellectually, or spiritually, ascertains truth determines the degree of his security and conditions his fitness for survival and prevalence; but man attained to both the perception and formal ascertainment of truth first through the *use* of and then through the *using* of his hands. The survivals of this are as striking as they are abundant. Let us examine only a few of them—this more in the way of suggestion for, rather than as the results of, adequate study.

I think that man is what he is, even racially to a certain extent, through this same use and using of his hands, he having been domesticated thereby, or by himself unconsciously, so far as to have changed himself and the degrees and modus operandi of the causes in outside nature which affected his development as an animal. If this be true of man in a general racio-physical sense it is certainly and much more obviously true of him in more special ways; as, for instance, in so far as he has modified himself by persistent custom or usage—usage rendered persistently specific through the limitations of his organism—his members acting upon and acted upon by environment, according to his condition.

For example, learned treatises have been written from all sorts of standpoints to account for the universal right-handedness of our race. It has appeared to me that the essential usages of primitive life have made man universally right-handed, or at least emphasized and confirmed in him any organic tendency that way; so that no students can ever have found a tribe or nation of wholly left-handed or even ambidextrous people, nor trace of them in art remains, although in the latter we may look among the earlier for more frequent signs of such than among the later.

Man the savage fends for life principally with weapons of war and the chase, of offense and defense. His heart, the most vulnerable part, is in his left side, which he would therefore even emotionally turn away from danger and encounter; but, more than this, his condition of life implies always the shield and the club. He has naturally always carried the shield over the heart with the left arm and hand; the club, lance, or sword in the right hand. He has thus *acted* constantly with the right hand; *carried* as constantly with the left. It is only natural, then, that in ritualistic talk the Zuñi should have called the personified right hand the "Taker," the left hand the "Holder," going so far as to deify the left and

right members of the Sun Father as the Elder and Younger God-Twins of War and Chance—A′-hai-yu′-ta and Ma′-tsai-le′-ma—one the deliberate, the counsellor, and maintainer; the other the impetuous, the proposer, and doer.

In this we already have an example of the agency of hand-usage in framing mind or forming both mythic concepts and religious beliefs, along the line of which one might follow far the upward growth of culture in a special people; but the example serves also to introduce to us a clearer, more distinctly graded line, each advance of which may be obviously traced and which is, in much greater measure, of universal applicability to studies of culture-growth in the entire human race.

The question has been asked, Why have we a cumbersome decimal system of enumeration when it is well known that a duodecimal system would be better? The question has been answered by Dr. Tylor and by many others, as by myself—we have the decimal system because we have pentadactylic hands. Whether we would or no, despite our mind, these hands have imposed upon us both the names and the figures for our numbers and numberings. The need for knowing in number arising in primitive time, *they* first responded; the will to know, *they* formed the way of knowing—the knowledge itself, for that matter. However well understood this may be as a general statement, I do not think the process of it has ever been quite fully or far enough traced out.

I. *Evidence of hand influence in the formation of terms in spoken language.*—By combining a sense of manual aptitude with the etymology of quantitive terms in at least the Zuñi language, I will feel my way back, step by step, to the far ancient hand-conception and birth of many such terms. I think it can thus be shown that, while the creator of such terms has been the human will, the father of them has been the right hand, the mother of them the left hand; that numerals have been finger-made and sums hand-made; further, that single terms or monophrastic words of many sorts have been single-hand made, and sentence-words or holophrastic terms have as often been double-hand or gesture made.

The immediate bearing of these latter facts is important, since they go far toward explaining why languages have been always ahead of themselves, so to say, grammatically; for they indicate that the very earliest uttered verbal speech was already framed

complexly by the two hands—one acted upon, the other acting upon it. That such speech as a whole had already advanced grammatically beyond the simple "bow-wow" stage and was, at the very outset, neither merely monosyllabic nor polysyllabic, but was—as from a purely psychologic standpoint Major Powell has independently demonstrated—necessarily a combination of these, or in part one, in part the other. And I venture further to say that it was full born with not a few well-marked parts of speech.[1]

II. *Right- and left-handedness as affecting the development of spoken numerals.*—Not so much to illustrate this genetic relation of the hands to speech-concepts as to show how essentially and very significantly right- and left-handedness has modified them, let us consider further the evolution of spoken numerals.

Admitting the universality of right-handedness and of the tendency to number with the fingers, then the right hand has ever been the counter, the fingers of the left hand the ones counted. Primitive man when abroad never lightly quit hold of his weapons. If he wanted to count, he did as the Zuñi afield does to-day; he tucked his implement under his left arm, thus constraining the latter but leaving the right hand free that he might check off with it the fingers of the rigidly elevated left hand. From the nature of this position, however, the palm of the left hand was presented to the face of the counter, so that he had to begin his score on the little finger of it and continue his counting from the right leftward. An inheritance of this may be detected to-day in the confirmed habit the Zuñi has of gesticulating from the right leftward with the fingers of the right hand over those of the left, whether he be counting and summing up or relating in any orderly manner. The subtle, far-reaching influence on mind, as well as on speech forms, of such simple and natural practices as these, arising from necessity in the way shown, has been so important that I do not hesitate to present the very tedious a, b, c's of its Zuñi record before proceeding to read that record further and translate more entertaining passages from it.

Vigesimal stage.—This record begins with the number One, or *tõp'-in-te*, which signifies "taken to start with," or, to be less explicit but more literal, "take-up-start-which-always-is-done-with-is." It is from (1) *t'a'-pi*,[2] to take up, in the sense of starting with; (2) *ın, i'-na*, the inself, in-dwelling quality, trait, or function of any-

thing[3]—it here signifies that which (itself which) always is (has)—and, finally, (3) *te'*, from *te'-u-o-na*,[4] (has) done to it—that is, *in-te''* means the particular thing to which anything is done; in this case the finger first taken up (Fig. 1).

The original meaning all this was intended to convey was, "that finger we always take first to count with," the equivalent of which, as a concept, was the little finger held up and dropped or put down, as implying *one counted.* The Zuñi language, like many another, had no name for each or any one of the four fingers. There was no such thing in it as spoken number with which otherwise to designate any one of them. What had to be done was what has been and what will further be shown was done. The process of counting the fingers of one hand with those of the other had to be described or indicated by vocal sounds.

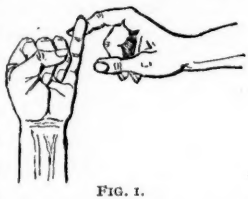

FIG. 1.

Thus, also, *kwil'-lin* (spoken alone) or *kwil'-li* (when counted), Two, originally expressed "dropped or put down together with that which," etc.; from (1) *kw'-i'-ho*,[5] to drop or let go hold of; (2) *i'-wi-li*,[6] together (with) like; (3) *na*, from *i'-na*, that which, etc., (as above). So we may say that the thought this conveyed was something like "that-(finger)-we-put-down-with-the-like-of-it," the equivalent concept of which was the next finger held up with the little finger (Fig. 2) and with it put down as implying *two counted.*

FIG. 2.

FIG. 3.

FIG. 4.

Ha''-in (spoken alone) or *ha''-i* (when counted), Three, was more ingeniously but far less simply devised as the "parter-equally-itself-which-does," etc. (the middle or dividing finger being meant; Fig. 3), by deriving it from *i'-ha-k'i-a*,[7] to divide equally or part in

the middle. This conveys much more clearly than English can render it, "the equally-dividing finger [*lit.*, 'the finger which separates the first taken and together with it fingers from the next last and cut off from it fingers'] which always we, as to the others, to it do," the equivalent of which as a concept was the little, next, and middle fingers together held up (Fig. 4), etc., as scoring three.[8]

A'-wi-ten (spoken alone), or *a'-wi-te* (counted), Four, is extraordinary, not only as a concept, but also as a device in sound for designating the (with us) index, or forefinger, as the *last* finger in counting four. It is a contraction of the sentence-word *a'-wi-ten-na*, all-of-itselves (them) to-be-done-with-going, or all-of-them (-selves) being-done-with-about-to; from (1) *a*, all, denoting, as a prefix, all of several; (2) *wi*,[9] of itselves, and (3) *ten'-a*,[10] to be almost used up. Thus the meaning this conveyed may be seen to have been "all of the fingers all but done with," the equivalent of which as a concept was all of the fingers except the thumb (Fig. 5) held up and clasped down as implying *four* counted.

FIG. 5.

Öp-ten (spoken alone), or *öp-te* (counted), Five, completes the list of origination-names of numbers, so to term them. Referring to the thumb, it simply means "the notched off" or "the cut off" (individual); from (1) *öp'-tse*[11], to cut or notch, and (2) *no'-na* or *o'-na*, used only as a suffix and meaning "the one which does" (makes), or "the one which is (meant)." The obvious meaning this conveyed was that the thumb was meant, the concept of which meaning may have been either the whole hand held up with the thumb separated, or notched away, from the other fingers (Figs. 6, 7), as implying *five*, or that the end or cut-off point (*öp'-ti-na-ne* or *öp'-tsi-na-ne* similarly derived; see note 11) had now been reached. At any rate, there is evidence that for a long period five was veritably the notched-off point or end of Zuñi counting.

FIG. 6.

Decimal stage.—When the enumerative attempt was again made, out of a long usage of the word one, another had been evolved from it, which, if possessed at the outset, would have saved much trouble in name-number devising—namely, *to'-pa*, signifying "another."

Thus, six became simply *to'-pa-lĭ-k'ya*, which evidences, moreover, that in going on thenceforward the ancient Zuñis merely performed and voiced simple additions with the natural abacus of their two hands. Thus, *to'-pa-lĭ-k'ya* signifies "another-bring-to-add-put-with-done (or made so to)." It is condensed from *top-ā'thl-il'-li-k'ya*, derived in turn from (1) *to'-pa*, another (from the word one; see note 2, etc.); (2) *a'thl'-na*,[12] bring to, add to; (3) *il'-li*, with (from *i'-wi-li*, together with, as in note 6), and (4) *k'ya* (the past participial ending like our own -ed), did, done.[13]

FIG. 7.

The meaning this conveyed was that all of the fingers and thumb of the left hand being held up (as for five counted—Fig. 7), another,

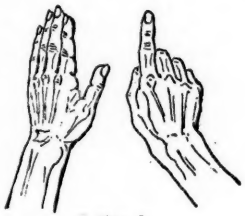

FIG. 8.

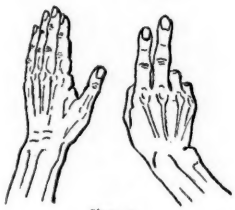

FIG. 9.

of the right hand, was brought and held up with them (Fig. 8) as indicating *six* counted.

Seven, *kwil'-li-lĭ-k'ya*, simply means two (fingers of the right hand) brought to and held up with the rest (of the left hand—Fig. 9); and eight, *ha'-i-lĭ-k'ya*, three fingers so held up, etc. (Fig. 10).

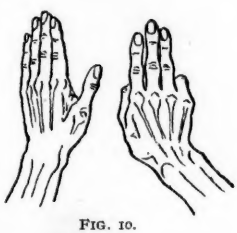

FIG. 10.

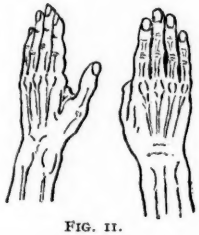

FIG. 11.

But in Nine, *ten'-a-lĭ-k'ya*, this process has been varied; that is, instead of trying to repeat the word four (as two and three had been

repeated in forming seven and eight), the process or principle of the *formation* of four is repeated or applied, so that the significance of *ten'-a-lĭ-k'ya* is that "all but all [of the fingers of the right hand] are held up with the rest" (meaning the left—Fig. 11).

Etymologically, Ten, *äs'-tem-'thla* (spoken alone), is the most transparent of all the number-names, for it simply means "all of the fingers;" from (1) *äs'-si*, fingers together (or as one—Figs. 12 and 13), and (2) *tem'-'thla*,[14] all.

Again, for a long period the primitive Zuñi seems to have paused at this next step in number building, simply saying "all of the fingers and"—whatever other number he fain would add, developing thereby, it may be, his independent word for "and" (*ţa*) from

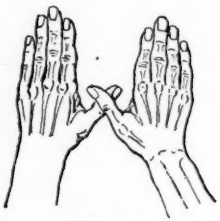

FIG. 12.

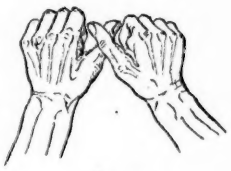

FIG. 13.

to'-pa. Be this as it may, his word for Eleven at last took the form of *äs'-tem-'thla to-pa-yä'thl'-to-na* (spoken alone), for he could not say again, "another put with the rest" (or with all that had been counted), since this would have but signified six again. He therefore said "all-of-the-fingers-and-another-over-above-held" (or cast up); for *äs'-tem-'thla to-pa-yä'thl'-to-na* is formulated from (1) *äs'-tem-'thla*, fingers all; (2) *ta*, and; (3) *to'-pa*, another; and (4) *yä'thl'-to*[15], laid upon or cast upon.

With twelve, thirteen, and so on, to nineteen, the process was but a repetition of this; but when twenty was reached, yet another device is discernible in the middle syllables of this number, *kwil'-li-k'yĕn-äs'-tem-'thlan* (spoken alone) or *kwil'-li-k'yĕn-äs'-tem-'thla* (counted), from (1) *kwil'-li*, two; (2) *k'yĕn*,[16] times done; (3) *äs'-tem-'thla*, ten—that is, "two times all of the fingers. One hundred is simply *äs-si-äs'-tem-'thla-k'ya*, or "the fingers all of the fingers (done to);" but one thousand is *äs-si-äs'-tem-'thla-na-k'yĕn-äs-tem-'thla*, "the fingers all of the fingers times (done to) all of the fingers."

III. *Right- and left-handedness as affecting the development of recorded numerals and writing.*—I have said that this study of hand influence simply in Zuñi number making and naming, etc., would apply almost universally and similarly to the study of such features in the growth of other cultures, and it remains to be represented in what wise and to what extent this is true.

(*a*) *The threshing score.*—Every one knows that the ancient score of Scandinavia and Anglo-Saxondom—our own threshing score—consists of four straight upright marks conjoined by a line drawn diagonally across them from right to left, to tally five (Fig. 14, *a*), and if the record be indefinitely continued, then in the succeeding set of marks the diagonal line is sometimes reversed, to tally ten (Fig. 14, *b*). This serves to launch us forth on the second line of our inquiry, for it looks as though these scores were at first only crude pictures suggested by the fingers of the left hand held up straight with the thumb folded across them to denote five (Fig. 15, *a*), and of the right hand similarly held by its side to signify ten (Fig. 15, *b*).

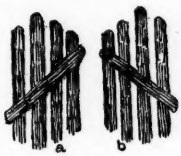

FIG. 14.

FIG. 15.

(*b.*) *The Roman numerals.*—But a less questionable and far better evidence of hand influence on graphic, not less than on spoken, numeral-making may be educed from a comparative examination and analysis of the letters selected and the methods employed in combining them to depict numbers according to the Roman system.

It seems more than probable that the figures or letters in this system representing all numbers up to ten, at least, were selected or devised[17] by their earliest inventors, in either deliberate or spontaneous imitation of the fingers of, first, the left hand, then of the right, as used and seen in counting. With this idea in mind, it is not difficult to perceive in one I, two I's, and three I's the little, next, and middle fingers as used in counting one, two, and three, and as illustrated in Figs. 16, 17, and 18. The ancient recorder of numbers found, however, in going further than this (in representing four, five, etc.) a necessity for modifying the uniformity of these straight number-marks in order that he need not stop to count them

each time he would determine their collective value in any given number. It is curious that his first effort to meet this requirement was but a repetition of the method employed by the primitive Zuñi in formulating his word or sound-symbol for the same number. To denote the finger-count for this number (four), the latter said, "all of the fingers [of the left hand] all but done with;" that is, all except the last, the one before, or the one lacking the last. Practically, the Latin or the pre-Latin scribe did this, too, in formulating his symbol of the same number; for, conceiving the whole hand held up with the thumb extended as representative of five (Fig. 20) and then adopting or making a V to represent this in turn, he has placed an I before his V to symbolize four, by indicating that the number

FIG. 16.

FIG. 17.

FIG. 18.

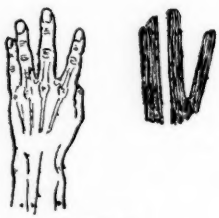

FIG. 19.

FIG. 20.

meant is the next to the last one of the first division or hand; in other words, the one before, or one less than five, namely, four (Fig. 19). Moreover, when the fingers are held up with the thumb clasped in, they are so separated as to suggest, in themselves, the figure IV. Precisely as the Zuñi went on from the "notch" or V,

so the writer goes on by adding to the right side of this V, or placing after it one I, two I's, and three I's, for his six, seven, and eight (Figs. 8, 9, 10). When he reaches nine, however, his process of formulation of the symbol of this number is seen to have been not less analogous to his earlier process (for four) than was the Zuñi's to his, when he dealt with the same number. For, unavoidably taking the two extended hands with the *thumbs crossed* (Figs. 12, 13) to represent ten as a whole number or a number by itself,[18] and then adopting X to represent this in turn, he repeats, as the Zuñi repeated, much the same process he used in devising four; that is, places an I before the last number-sign (X, or ten) to indicate one less than, next to, or before it; that is, nine. It will be observed that this order of succession in recording the combined number signs reversed the direction of progression in the earlier counting or number development. None the less, it is still an effect of sinistral number-making, for it obviously had origin in the habitual turning toward the left to begin with, as well as in the addition from the right hand of all number elements exceeding and succeeding five; and, again, in the dextral appearance of the left hand as seen by the spectator or one counted to.

(*c.*) *The Chinese numerals.*—Dr. Weston Flint called my attention to the Chinese numerals as possibly originally pictographic in some such way. On examining the earlier forms of these characters expressive of number, I find that they but illustrate another application of the methods above outlined, for the marks representing one, two, and three are at once recognizable as depicting the little, next, and middle fingers of the left hand, held horizontally, however, and therefore read vertically. Four seems a representation of *nearly* the whole hand, and five, originally at least, of the whole hand, both on the same plan. Here again the influence of counting numbers on the hand may be seen to have affected the direction of number-recording as well, which with the Chinese is vertical, not horizontal, and which has in turn determined apparently the direction of all their writing. That like hand-usages in numbering, then recording, had equally determinate influence on the trends of nearly all other systems of writing could be almost as easily shown.

(*d.*) *Other than delineative number records:* (1) *Tallies.*—Let us now discuss some other than delineative methods of number-recording which are more appropriate here, as they appear to have been in-

fluenced no less by finger-counting in identical ways. Such are the notched tallies on which either a V-shaped notch (*a*, Fig. 21) or its

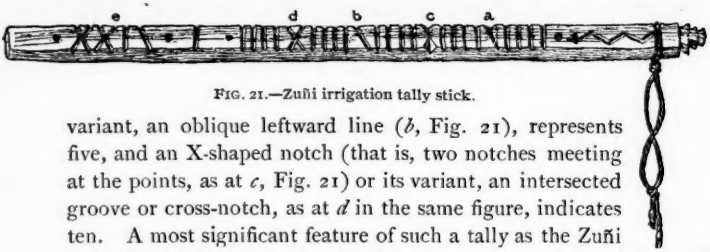

FIG. 21.—Zuñi irrigation tally stick.

variant, an oblique leftward line (*b*, Fig. 21), represents five, and an X-shaped notch (that is, two notches meeting at the points, as at *c*, Fig. 21) or its variant, an intersected groove or cross-notch, as at *d* in the same figure, indicates ten. A most significant feature of such a tally as the Zuñi irrigation stick is that when used as an unbroken score the record begins at the right end, progressing toward the left; but when the numbers are separated on one, as in the dance calendars, then each is read from the left toward the right for a reason already given, though as a whole it may still be read from the right leftward. The name of such an instrument in Zuñi is also suggestive. It is *a'-wi-yăl-li-ni-k'ya 'thlam'*, "all-of-itselves-to-make-up-come-successively-for stick," or "all of them [the finger or number marks] to make [show] up after one another stick for;" *i'-yă-li-k'ya*, to count, being, as far as it goes, similarly derived—that is, from the practice of showing up the fingers successively in counting.

(2) *Knotted strands or quippos.*—No line of this inquiry is more interesting than that of hand influence on number and other recording by means of knotted strands, because while fortifying the claims of this thesis, it at the same time reveals important features in the hitherto unexplained origin and development of quippos. The Zuñis had made a beginning in this strange sort of string-writing and with it plume-writing.

From their language it may be gathered that they once had "song-strings" or "song-lines," "tribute-strands" and "war-cords" or records, etc., survivals of which may now be seen in the mystic knots of their secret cult societies and in the variously knotted cords appended to their sacrificial plumed wands which are supposed to tell their prayers to the Beings of Space.

The simplest knot known to the Zuñis was spoken of as the "finger-knot" (Fig. 22), because tied by a twirl of the forefinger alone, as the same kind of knot is now tied by seamstresses. Because tied with a finger, it was not only known as a finger-knot, but

came naturally to mean *one*. Two such knots meant of course *two*, and three such knots the number *three*. The finger-knot, given an additional twirl by means of the thumb and forefinger together (as used in joining two threads by expert weavers and spinners), be-

FIG. 22.

FIG. 23.

came, with the Zuñis, the thumb-knot (Fig. 23). Now the thumb-knot, of course, meant five, and this with a single finger-knot before or above it meant four (Fig. 25), and with one, two, or three finger-knots after or below it, meant six (Fig. 26), seven, and eight.

So also either the knot which required two hands for the tying of it, or the double thumb-knot in one (Fig. 24), came to mean "the two hands," and so *ten*. By placing a single finger-knot before or above this double thumb-knot (Fig. 27) *nine* was

FIG. 24.

FIG. 25.

FIG. 26.

FIG. 27.

FIG. 28.

signified, whilst a double thumb-knot followed by a single finger-knot (Fig. 28) meant eleven, and two double thumb-knots followed by a single finger-knot (Fig. 29) meant twenty-one. In all these we see precisely the same principles of reasoning and processes employed (because always suggested, or indeed made needful, by the hands) that have hitherto repeatedly been exemplified in this paper.

It may readily be inferred that a people given to weaving, netting, feather-twining and embroidery so much as were the ancient

Zuñis and Peruvians would hit most naturally upon this method of recording, and that, possessing such basic knot symbols as have been shown, might go much further toward veritably weaving or knitting forth their most intricate thoughts.[19]

FIG. 29.

IV. *Influence of hand usage in left and right finger-counting on ceremonial successions, etc.*—It is now possible to demonstrate the controlling influence of finger-counting on the successional arrangement of the cardinal points or world divisions, and therefore on the lines of succession and directions of turning in ceremonial circuits and serial-marshallings, and of organizations of these and other kinds, as well as of the structural arrangements appertaining thereto.

It is the same to-day as it was in times ancient with the Zuñi when he uses his fingers as indicators. When calling attention to a single object only, he points as we do, with the index finger of his right hand; but if indicating a series of objects, then he

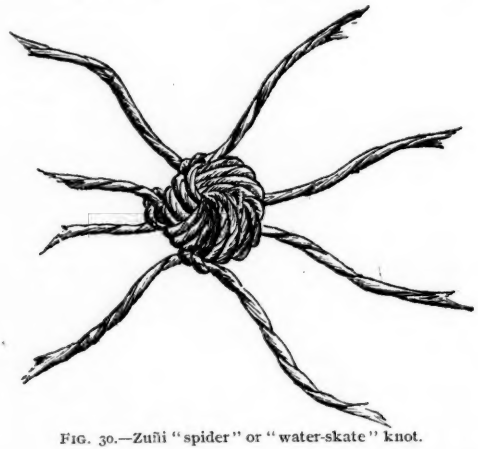

FIG. 30.—Zuñi "spider" or "water-skate" knot.

points out the first one with the *little finger* of his *left* hand, palm upward, and the second with both it (involuntarily) and the finger next to it, whilst the third object will be pointed at with the middle finger, the fourth with the index finger, and the fifth still with the index finger, but with the thumb extended and the palm turned upward.

If, say, the third object be pointed at a second, third, or fourth time, invariably the middle or third finger will again be used as at first, and it is likewise with whatever finger agrees with the serial number pointed out or meant a second time or repeatedly. This forcibly shows the power of apparently trivial action-habits to survive throughout indefinite numbers of generations; for this peculiar usage in indicating can only be conceived to have arisen before the origin of adequate speech in the effort to indicate connection, succession, and rank or precedence by means of gestures; that it was thenceforward kept up in the relating of successive events, even after names for numbers had been developed, but while yet no words for first, second, third, and fourth had been evolved from them, is equally conceivable, and that the inception of all this was involved in the origin of finger-counting itself, is at once apparent; that it would also influence (through gesture indication and naming) the placement in succession of the cardinal points, etc., may be made evident if we consider some of the aspects of primitive man toward extraneous nature. To him, the all-important factor in the universe was the Sun. It was the Maker of day and Renewer of life each morning. As such its chief place was the point on the horizon whence at dawn it came forth. Therefore all other points of the horizon would at first be located or arranged with reference to this one; but with all ancient peoples who, like the Zuñis, normally developed their numerical system previously to or alongside of their ceremonial placing and naming of the cardinal points (or sources of the wind-phenomena and gods), these points were but naturally arranged serially and *leftwardly from* the east, or the region of the rising sun. With this in view—and itself already indicated by the mere gesture for the rising sun—the next point, or the north, was, of course, the first thereafter. Therefore it was necessarily indicated or counted (according to the usage I have described) with the little finger of the left hand, and consequently came to be referred to as "the first finger [cardinal] point," and hence conceived of as the *first* cardinal point, a conception which, through mythical fitness, would surely prevail. In the same way the next cardinal point, or the west, being symbolized by the second or next leftward finger, became the second cardinal point, the south the third, and the east the *fourth*[20] instead of the first. Finally, with a people far enough advanced, the next point to this, because in the direction of the sun rising from it, was the zenith, and the next to

this in turn (because following the setting sun to the world of night) was the nadir, whilst the first and seventh as well was this world itself, or the center of them all.

Each cardinal point was characterized by many things differentiating it from all the others: in the Northern Hemisphere the

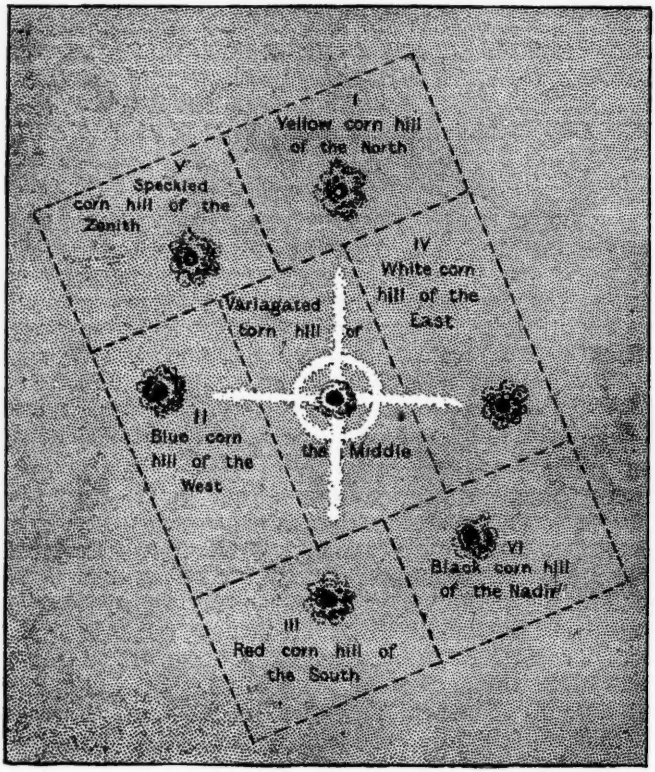

FIG. 31.—Ceremonial diagram showing distribution, etc., of corn-hills in consecration of field.

winds of the North were cold, bringing winter; those of the South warm, bringing summer. So the East was the land of day, of awakening and "life-completing;" the West the land of night, of sleeping and dreams, death and souls or "life-finishing," whilst

the Above was the world of clouds, and the path of day the source of seed; the Below, that of darkness and its terrors, yet the place of fertility and growth and of all becoming.

Nevertheless, though one journeyed afar, this world remained measurably the same; for the north, the west, the south, and the east remained ever the same in relation to it. Their phenomena were ever present, yet *they* were ever beyond. They must, then, be Worlds or Regions by themselves, and must be peopled by great gods, the causers or commanders of their severally characteristic phenomena, whose representatives in this, our own world, or the Place of the Middle, must be the animals, mortal or phenomenal, specially resident in the northern, western, southern, or eastern parts of this world.

The Masters of all these Gods of the Spaces and God animals of the related regions were those of the North, because resident in the First region and because, therefore, the Elders, as among men the first are the Elders and Masters. For that reason, no doubt (thought the primitive Zuñi), they were the most powerful, hence the fiercest; the most implacable, hence the first (yet most difficult) to be propitiated.

Thus, too, the gods of the other regions assumed their ranks and supposed relationships, those in each of the series becoming the younger brothers of those in the last before it, and their relative powers and mutual dependencies were explained with unfailing and equal readiness. Thus, until the Gods of the North withheld their icy breath, how could those of the West or the souls there breathe moisture over the land? And until the moisture from the West came, how could things grow in the warm breath of Summer sent by the Gods of the South? How mature and ripen without the age-drying drouth and tempering breath of the Gods in Dawnland?

Now, in order that these Gods of the several regions might be properly approached and entreated, wise men (the Elders of clans related to or most nearly connected with the chief animals of these same several regions, hence named after them) must become their Protopriests, and since thus constituted the Protopriests, of, say, the North, they were in special favor with the Gods of the North. Being of the North, they must be the First, the Elders of the other Protopriests, as their Gods are the Elders of all the other Gods. They also must have a place named of the North, their next younger brothers a place named of the West, and so on. So also they must

have followers of whom they are both Fathers or Protopriests and Chieftains, and these are the children of their own clans named after the animals of the North, and finally these children or followers must in turn have an abiding place, which shall be called the "Place of the North," in which shall be the precinct of these Protopriests of the Northern Gods, wherein they shall worship and keep their sacred "Powers and Medicines," their symbols and fetiches of Winter and the North, wherein to hold their secret assemblies. Thus, too, it must be with each other region—it must have its Protopriests and they their followings, all properly assigned in places cardinally named or "word-placed."

The number of regulations which such arrangements have given rise to with a people like the Zuñis is legion, dramaturgically affecting, as it has, absolutely all their ceremonial life and well nigh all their institutions and organizations, whether religious and sociologic or regulative and merely governmental; whether of the tribe, the clan, or the family, or whether in the arrangements of the town, the kiva, or the dwelling. As an instance, the order of all dances during the year must accord with this, for the clans take precedence in the times or seasons of the celebration of these, mainly with regard to the relation of their totems to the North, the West, the South, the East, the Upper or the Lower regions, and the relations of these in turn to the elements of wind, water, fire, and earth, and to winter, spring, summer, and autumn. Yet in each dance or celebration each region must be represented by appropriate leaders of sections, whose precedence is arranged with like due and scrupulous regard to the sequence of the several regions and seasons they also represent.

Formerly the greater divisions were far more pronounced than now, as may be inferred from the fact that the Zuñis are the descendants of dwellers in the celebrated "Seven Cities of Cibola;" for in these the totems of the North dwelt in a village by themselves, those of the West in another, of the South in another, and so of the Eastern, Upper, and Lower, whilst those of the Middle dwelt in another town, apart from all the rest, itself subdivided into wards or septs (as is modern Zuñi), itself also the tribal head—ceremonially ruling all the rest, yet ruling through resident protopriestly representatives of and from all the rest, in due order of precedence; only, here in the Midmost place, these were under the Sun or Father-Protopriest, and the Seed or Mother-Protopriestess, in at least all

religious and ceremonial concerns. A curious prototype or parallel this, it would seem, of Cuzco with its upper and lower divisions, and therein paired wards of representatives and rulers from all the "Suyus," and over all its Inca Father of the sun, its Inti Mother of the earth.

Again, in at least the central town of Zuñi were (and are) six kivas; but in any one of them any ceremonials relating specifically

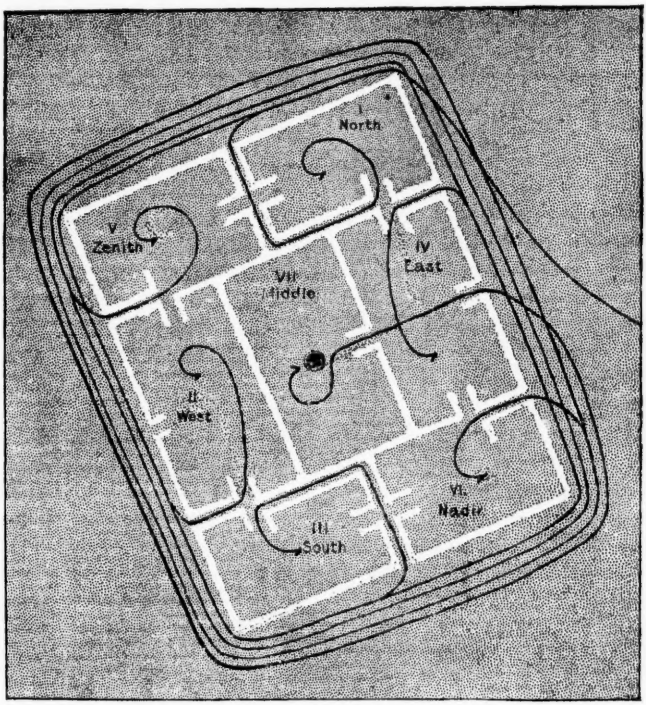

FIG. 32.—Ceremonial diagram in prayer-meal of the seven ancient spaces, showing four-fold circuit of entrance.

to all the regions will be performed by the leading Protopriests of the North, West, South, East, Upper, Lower, and Middle regions, each duly placed within a division of a diagram on the floor made with prayer-meal (Fig. 32) of all the kivas arranged around a central

space so that all may be entered from the right ("east") leftwardly in a four-fold circuit or "procession of seating," first, of "The Four," then (second) of the Uppermost, then (third) of the Nethermost, and, finally and singly, of the Midmost "Father" or "Seater of All." [21]

In each of the great cities or aggregations of pueblos which we excavated in the Salado and Gila valleys, I found that these six kivas were there also aggregated, like the many pueblitos, into a temple kiva as it were, the home or storehouse and stronghold and the place of sacred assembly of the Protopriest rulers over the wards or pueblo divisions of those cities. Each of these structures, which I have heretofore perhaps injudiciously called temples, contained from one to six or seven superimposed *sets* of either five (as in the celebrated Casa Grande, Pl. I) or seven chambers or halls of ceremony (as in the great kiva mound of Los Muertos). If five, then the Northern and Southern were nearly twice as large as the others, to represent not only the Northern and Southern but also the Upper and Lower regional divisions. It is significant, too, that the circuit of these chambers was made from the east, and thence leftwardly to the north, west, south, and east, and finally from the east to the center, whence no connection by doorways was provided with any of the other rooms than the eastern (compare above plans). The temple of Vira Ccocha of Peru was built on a grander scale, but on this same plan, and it is safe to say that both kinds owed their origin and probably placement, as heretofore suggested, mainly to such placing and sequence of the cardinal points as I have referred to. It is not too much to assume that this placement was founded upon unavoidable prehistoric usages of the hand, whether or not it denotes identity of culture origin.

It has been my object rather to suggest that the hand of man has been so intimately associated with the mind of man that it has moulded intangible thoughts no less than the tangible products of his brain. So intimate, indeed, was this association during the very early manual period of man's mental growth that it may be affirmed to be, like so many other hereditary traits, still dormantly existent in the hands of all of us to a greater or lesser degree.

For the hands have alike engendered and attended at the birth of not only all primitive arts, but also many primitive institutions, and it is not too much to say that the arts and institutions of all early ages are therefore memorized by them. In other words,

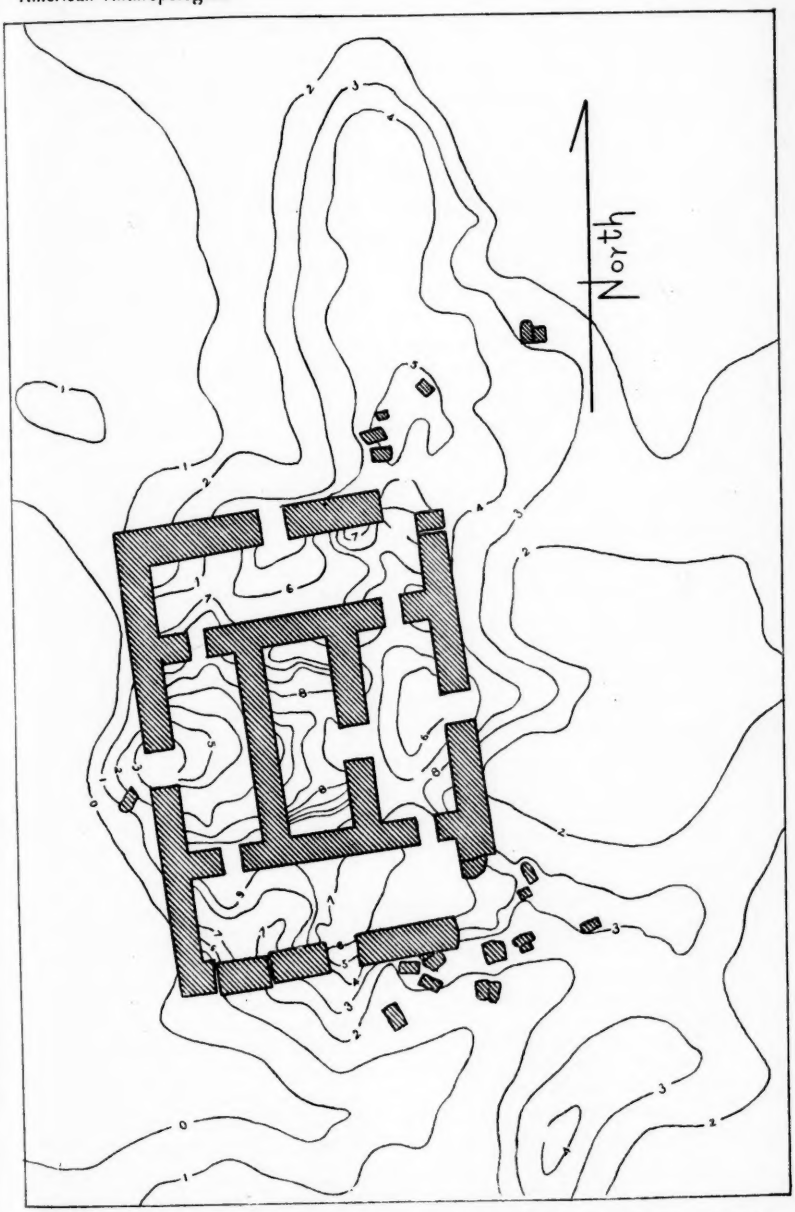

PLATE I.—Ground plan of Casa Grande, showing orientation. From survey made by Cosmos Mindeleff of the Bureau of Ethnology. Scale about 20 feet to 1 inch.

their acts and methods in the production and working out of all these arts and institutions survive as impulses within them, as do obsolete organs in changed animal species; yet more, they survive according to well nigh the same laws of persistent organic inheritance.

It is chiefly through these survivals within the hands that the embryology of the arts themselves may be traced and studied, a knowledge of which subject is as essential to the proper understanding and classification of man's technical activities, at least, as was that of organic embryology to the comprehensive view and modern classification of biotic species.

The method of retracing these lost steps in the growth of the arts surviving in the hands of man is comprised in simply turning these back to their former activities, by reëxperiencing through them, in experiment with the materials and conditions they dealt with in prehistoric times; times when they were so united with intellect as to have been fairly a part of it.

That these survivals are so potent still as to make the hands alone fairly infallible guides (almost without the aid of mind, save to give, as it were, hypnotic suggestions to them) toward the reconstruction of any work or activity, however complicated, that was long persisted in during periods in the development of our race; and that such experimentally re-awakened hand faculties work so perfectly and independently in the main that they form almost a sixth sense, a manual-mental method of true divination concerning the lost arts, I shall hope to show in another paper on the Interaction of Hand and Mind in the Growth of Culture.

NOTES.

1. Investigation of the Zuñi language in reference to this idea is quite conclusive in this respect. The entire language is freighted with fossil concepts, and in studying closely the structural organism of these dead ideas one finds how they were born and grew, and that they were more often than not both implanted and made to grow by the hands alone: 1st, as used in action or in simulating actions; 2d, by the vocal imitation of the sounds naturally associated with such actions or with their effects. This is exemplified in a measure by analysis of the Zuñi term "to kill," which is *a'-yi-i-nä-tï'*, to hurt in a violent or deadly manner; from (1) *a-yi'* + *!*, the exclamation of pain or cry of distress or hurt; (2) *i*, itself; (3) *in*, which is, etc. (*i. e.*, that which is meant, as explained elsewhere);

and (4) *te*, to be or being, which, changed into *tï'* (from *te-ïh'* or *t'ïh*), comes to signify "something being done to it," (viz., that which is meant, *i. e.*, the one violently hurt). In this it may be seen that *a-yi'* + *!*, the cry of inflicted hurt, came to mean, when accented, hurting, because it always resulted from hurting; and, with the addition of *i-na-tï'*, virtually "that (or itself which) has done to it," etc., it came further to mean hurting anything. By itself, however, *a'-yi-i-nä-tï'*, like the Spanish *matar*, might mean either to kill or only to beat or otherwise violently hurt. That it might be made to mean actually to kill, "very" or "really" had to be prefixed to it, as, *äs'-shee-a'-yi-nä-tï'*, really or very (much) to kill. Now, *äs'-shee* is derived from (1) *äs'-sï*, hand or fingers; (2) *ï'ssh*, extremely exerted or clutched (doubled up tightly); and (3) *te*, it (or they) being. In this construction a two-fold record is beautifully preserved. It reveals the fact that the hand was used to express "very" by being doubled up or clinched tightly, and *ï'ssh'-te* was an equally appropriate sound with which to describe or vocally convey this symbolic act, since it simply exaggerates the suppressed grunt, *ï'ïssh*, almost unavoidably uttered when one is very tightly squeezing, or grasping with might and main. This same natural expression or exclamation of effort (*ï'ïssh*), formed the root of many related terms, some directly derived, as *hï'-ïsh-te*, excessively; some indirectly derived, as *äsh'-shï'-a*, to die; *äsh'-sk'yën-na*, making (in the sense of fashioning); and *äsh'-k'eya*, to do, in the sense of to make and to make to (do), whence "compel," etc. All this is but a mere tithe of what might be given, not only along the special lines just illustrated, but further, to show that the extreme specialization of verbs—active verbs particularly—in primitive languages is also probably due, first, to the essential relations of the hands to such acts or in the imitative repetition of them for expression, as above; second, to the limitations of manipulatory operations with only primitive or stone-age appliances (see note 11), one long-surviving inheritance of which would seem to be the irregular verb in modern languages. At any rate, the etymology of verbs, as well as adverbs, in the Zuñi, divides them at once, constructively, into several classes; for instance, those directly derived; in verbs relating to acts performed with the hands, as, with something, to something, at something, in something, out of something, from something, etc.; and again, verbs relating to acts performed (or actions occurring) without the agency of the hands, less directly derived, by vocalization of the sounds accompanying such actions or occurrences, modified by vocalizations suggestive in like manner of the hand imitations of parts of such actions or occurrences. In this fashion the so-called verbal genders or inflectional devices for specializing mode or relativity in any one of these verbs of action have resulted, in a majority of instances, from efforts to thus suggest or picture in sound, *particular* hand-relations to the acts, or rather *parts* of acts, or gestures of the actions or parts of actions, they signify. There was in this process grammatical inevitability. In itself it could not fail to effect

complex, yet mechanically systematic, expression-thoughts or utterance-concepts in the minds of primitive men before or as fast as they evolved even approximately equivalent verbal utterance. So, in one sense, at least, the literally manifold original languages of man were in old time born, as are the infants of men to-day, pre-natally organized and formed.

2. *T'a'-pi*, from (1) *te'-a*, being (there); (2) *a'ha*, to lift suddenly from or displace; (3) *po'-a*, standing (there); (4) *i'-in*, toward self. (See note 3.)

3. *I'-in*, from *i'-me*, to be sitting, whence *in'-nai-e*, to be sitting or dwelling within; *in-na-i-ne*, the constantly within-sitting or in-dwelling, the inself itself of a thing (the thing or part of a thing meant).

4. *Te'-u-o-na*, from *te*, contraction of *te'-a*, to be, whence *te'-u*, to do, and *te-u-o-nat'*, the one which has done to it.

5. *Kw'-i'-ho*, from (1) *kwa*, not; (2) *i*, self or itself; (3) *i'*, off of division; (4) *ho*, need (not), a derivative of *hâ*, I myself; (whence *hâ'-i*, being, an existence—anything having "I" or "myself" in it—*hâm*, of myself, and *hom+* or *hom'-a*, of myself got mine; whence again *ho*, essentially of or to myself).

6. *I'-wi-li*, from (1) *i*, self or itself; (2) *wi*, selves or more of self; (3) *li'-a*, like in line or form.

7. In turn derived from *i'-ha-ki-'thl-na*; (1) *i*, itself; (2) *a'há*, to lift from or part, etc.; (3) *k'i-'thl*, an-axe-as-with (in hacking and breaking sticks); (4) *na*, self-which-is, etc.

8. It will be noticed that in this name for Three, *ha'-in*, derived from *i'-ha-k'i-na*, two very significant sounds are omitted—the prefix *i* (the thing itself which is, etc.) and *k'*, a still more important initial sound of the second syllable, since it chiefly shows what is done to that thing. But it must be remembered that the primitive Zuñi habitually counted up to the number he meant to express, and in thus putting his separate numerals together he as effectually wore off their edges as though they had been material objects. In saying "one, two, three, four—four" he would encounter the difficulty of repeating the terminal vowel of his word for two, with the prefixed sound in his word for three (*kwil-li' i'-ha-k'i*), which would render the prefix sound meaningless and lead to its elimination. So, also, in going on to count four—*i'-ha-k'i a'-wi-te—k'i* run into *a* would confuse the meaning so that it too would be suppressed to a mere catch in the breath before the terminal *'i*.

9. See note 7; *i*, meaning self, the object referred to, following any other of the vowels, usually becomes *wi*, expressive generally of agreement in number; but following *a*, it usually implies not only plurality, but also the dative relation or possession, as expressed by to and of; hence, *a-wi*, all of them, corresponding in this respect to *a'-wa* or *a'-wan*, all of theirs, which is made up (by adding *w* in the same way) from *a*, all, and *an*, its, to or of it.

10. *Ten'-a*, from *te'-a-ni*—(1) *te'-a*, to be; (2) *ĕh*, left off or out, and (3) *a'-ni*, going, or *a'-na*, going now. The latter form is in turn derived from *an-ĕ'-ha*, will be going (at once), or, is about to go (away); from *an*, to go or move; *ih*, to make start (that is, suddenly, probably from the effort-exclamation of throwing, used as representative of a gesture to catch up and cast), meaning start, or to make start; *a'ha*, to displace, etc. (see note 2). The simple syllable *te* originally meant space, as found in *te'-'thlā-shi-na* (ancient space); *te'-k'o-ha-na*, daylight (= whited space); *te'-k'wi-na*, darkness (= blackened space); *te'-ul-in*, interior (= enclosed space), etc. *Te'-a*, to be, seems to contain this element, possibly derived as *te* space, *a*, there, something (out) in space. It is necessary to consider this fact as bearing on the close identity of *ten'-a* (being used up, exhausted, empty) with such unrelated words as *ten-i*, laborious, difficult; *ten'-a-la-a*, time; *ten'-nan-ne*, song; *ten-ā-ti'*, fate, inexorableness, etc.; all of which readily may be traced to kindred beginnings and gestures.

11. *Öp'-tse* or *äp'-tsi*, from (1) *ä'-chi-ën-ne* (a stone knife); (2) *pa* or *po'-a*, to place against or on; and (3) *tsi'-a-ä-ti*, to tear violently. *A'-chi-ën-ne* (knife) is itself derived from (1) *a'-a*, a stone; (2) *chi'-a*, to scrape, and (3) *ne* or *ë'-ne*, anything made for, the suffix invariably added to the names of instruments, and derived from elements in the word to fashion or make with the hands. (See note 1.)

12. From *a'thl'-na-ti;* (1) *a'-ha*, to displace or lift from, etc. (see former notes); (2) *'thle'-a*, to carry or bear (with the hand); and (3) *ti'-na*, to stand or station beside.

13. I am not yet certain about the derivation of this important verb-particle, the soul of Zuñi verb changes. It is possibly from *ya'-k'ī-a*, to complete, itself of intricate derivation, from *ya'-a*, to grow.

14. *Tem'-'thla*, from (1) *te'-a*, to be (see former notes); (2) *em'-ma*, much (to repletion); *'thle'-a*, to carry to, etc. (See note 12.)

15. *Yä'thl-to-na*, probably from (1) *i-yäh'*, to catch or snatch up; (2) *'thle'-a*, to carry (with the hand); (3) *ti'-na* to stand beside; (4) *o'-na*, that which is; something which is.

16. *K'yën*, doing, done, or doing repeatedly, from *k'ya'-i-ne:* (1) *k'ya*, done or done to; (2) *i'-a-ne*, itself going on.

17. It will much surprise me if it be ultimately learned that such letters of the Roman alphabet as were used simply or combined for the recording of the cardinal or index numbers were not *first* used *thus*, and *afterward* incorporated in or enlarged upon to make or modify parts of an alphabet as otherwise employed; for I believe that number-making was, with primitive man, literally his first hand writing, and that one more important clue for our understanding of how arbitrary and phonetic elements and writing were introduced into picture and syllabic writing, etc., will be found in this, as a natural outgrowth of the manifold mythic con-

ceptions of or symbolic values attached to numbers, and hence to their symbols, by primitive man. Not only could the figures of these numbers, therefore, be combined with other figures to convey the *sounds* of the number names themselves for expressing related sounds, but the well-known regional, color, and other primitive and mystic meanings of numbers (and hence their figures) could have greatly multiplied the meanings of figure-signs when employed as letters or as elements with which to modify meanings of other symbols, especially when with the latter it was sought to depict abstract ideas.

18. I was not a little astonished to find that the Zuñis did not consider the two hands held up apart as meaning ten. I can illustrate this and its cause by my first experience of it as a Zuñi. Whilst I was serving an apprenticeship with the chief silversmith of Zuñi, in 1881, he asked me one day how many *li'-a-li-we* (silver bits or dimes) I had. As my mouth was full of buttons I held up both hands spread out and apart, to assure him that I had *ten* ten-cent pieces. "Alas, son!" said he, "I already have *two half-dollars*," but I was hoping you had ten-cent pieces enough to exchange for them." "But I have," said I, ejecting the buttons and resuming speech in my surprise; whereupon he laughed at my having "*split* the sign for ten," making it "two fives," which he had interpreted as meaning two half-dollars.

19. I have ventured to suggest how this could have been effected with the numeral marks. That with knots it could have been even more readily accomplished I will presently illustrate. The primitive Zuñi, supplied already with an embryo alphabet in the shape of his number or numerical knots, could not only have employed combinations of these to symbolize the mystic or ritualistic values of the numbers they represented themselves, but he could also have greatly amplified the range of significance in the latter by varying the materials of the cordage with which the knots of them were tied; for with him each kind of fiber had a "flesh-name" indicative of its individual nature and function. Again, each of the six common colors with which any one of these strands might have been dyed had a definite regional or locative and successional as well as mythical significance. With all these accessories it was both possible and easy for the ancient Zuñi to modify and elaborate, and so to multiply the primary and even secondary meanings of mere knots. That this was more or less done, according to the above surmises, may be exemplified by reference to one or two of the symbol-knot survivals in the ritualistic paraphernalia heretofore alluded to.

The "spider" or "water-skate" knot of the Zuñi secret cult societies of war and the chase was tied usually with a four-fold strand (Fig. 30). With the ends of the two middle strands at one extremity shortened by twirling together, the node signified not merely the spider, but the *chief power* of the spider—that of snaring invisibly. If the knot were tied in yucca-fiber it signified the desired magic power of the initiated hunter

to capture or ensnare the heart of the game, the yucca-fiber symbolizing the hunter, because it was capable of withstanding rain as his bowstring, was used for his sandals, abounded wherever he roamed, and was therefore always employed by him to tie the legs of the game he had slain, and was held to symbolize the heart of the animal to be captured when taken from the heart of the plant itself. (See Zuñi Fetiches, Ann. Rep. Bur. Ethnol., II, p. 35). Placed on the trail of a startled deer, the yucca spider-knot constituted a hunter's invocation, asking that the deer be retarded, or that his heart be entangled and his footsteps confused. If the front strands were twisted to points, or the natural spines of the yucca leaf were left on them, and so placed as to point toward the course of the deer—backward along his trail—then it constituted an invocation that the deer be not only retarded, but also that the warrior be enabled to outstrip him and stop short his course with his arrows—sharp-pointed as the preying horns, probosces or short fore-claws of the spider were pointed. Made of sinew from the mountain lion, this same knot became the *warrior's* invocation-offering on the trail of the enemy, with even a greater capability of varied meaning, whilst if made of cotton (the flesh of the fair goddess) it was the proto-priest's prayer-symbol beseeching light and the power of detecting and entangling the ghostly emissaries of the dread sorcerer.

The knot of the water-skate differed from the spider-knot only in the shorter antennæ and greater length of the strands, which were made, moreover, to radiate more equidistantly from it; yet it had a significance marvelously apart. As a whole it represented not the water-skate only, but the world itself; because the water-skate, ever resting over the pools as the world rests over the primeval sea, and possessing four radiating legs and two pointers as the world is the center and possessor of the lines of the four quarters and of the zenith and nadir, is the god of the world or rather of the seven regions. But, made of yellow, the knot became the sign of the north-god region; or of blue, that of the west god, and so on. Again, if made of yellow (north) and red (south) intertwined, it became the symbol of winter and summer; or if of yellow, blue, red, and white, then the symbol of the four seasons. To merely hint the further possibilities of this simple symbol, it remains only to be stated that the skate-knot of dun-colored cotton, in the upper loops of which some untwisted flecks of cotton-down have been lightly twirled, comes to signify "the clouds of the world." But I will only add my opinion that the quippos will be found to have had a development from such mythic and mystic hand-made beginnings as these, and that with equal likelihood the presence of the numerous knot-symbols in the painted or carved writings of Mexico and Central America have had a similar genesis—that is, in a former practice of knot-recording and a symbolic meaning of knots in paraphernalia and the arts, etc.

20. As I have said, this seems the normal line of development, ceremonially, since it has characterized the greater number of ancient tribes and peoples, especially those inhabiting single regions for long periods. But there are exceptions. The nearest northern neighbors of the Zuñis, the Navajos, neither recognize the same number of regions the Zuñis do, nor do they name or range them ceremonially from the right leftwardly, but from the left rightwardly. This arose probably, as I have suggested, from the fact that their relative progress in ceremonially naming the world quarters and in naming their numbers was not the same. This would likely be the case with a wandering or unfixed people, with whom also in rare instances some factor, such as the direction whence they migrated, the source of something important to them, or a variety of other influences, would operate to render some one of the cardinal points more important mythically than another—that is, if the rising of the sun and its course rightwardly to the south and west had not already done so. Furthermore, the lack of the relative number-names up to four, either in gesture or speech, would leave the sequence also more likely to take a dextral turn, of course, than a sinistral tendency. This might and probably would be transformed to a sinistral succession after the development, in the ways I have described, of a more perfect number-phraseology, or the adoption of a more sedentary habit of life within a circumscribed area. The wandering or drifting peoples, at any rate, more often range the cardinal points dextrally than sinistrally, and their point of departure is usually also from the east or the rising of the sun, whilst the opposite is, in a like general sense, true of more settled peoples.

In view of these facts, great importance attaches to a study of the particular conception and arrangement of the world quarters, characterizing any given tribe or people, or shown in monuments of such; for their former condition of life and often even their earlier habitat, or again, in case of vanished peoples, their grade of culture can be correctly approximated therefrom. Many lines indicative of this might be followed up, but I will here essay limitedly only one, because it seems to illustrate quite importantly yet another consequence of the sinistral arrangement as above accounted for. Naturally the wanderer locates the cardinal points by the sun, usually, therefore, making the east his first point, the south his next, and so on. No matter how far he may fare, his cardinal points, so far as he takes account of them, will be true to the sunrise at the time of year when he locates them. Not so, however, with a people long settled in one region, then migrating to and settling in another. Their chief cardinal point having previously become the north in ways already shown, they are far more apt to misplace it, either accidentally or intentionally, and accordingly all the other quarters, than are wandering people who locate theirs by the sun only: (1st) because, having a full sense of the cardinal points of their olden home, they will endeavor to adjust these old points to the new locality, and in doing this will almost unavoidably vary toward the left or west from the true north in

this new country to the extent of at least the solstitial variation at the time, if not to a greater degree. In the latter case, they will claim and locate (2d) because of reasons which will presently be made evident, only *one* set of *quarters*, but *two* sets of *directions*, one—the sacred and "true" world-directions, the other those of the "new country" or of the people they find there.

Illustrations of this are not rare even in America. The Tusayan Indians of Arizona exemplify it in uniformly placing their sacred or world divisional north to between forty-five and fifty degrees west of north, and in constructing some of their kivas accordingly. For a kindred reason the great sacred citadel kivas or fanes in the ancient cities of pueblos in the Salado valley, discovered by me and excavated by the Hemenway Expedition, were found to have been placed with reference to a preconceived or else conventional set of directions. But this arbitrary placing of the world quarters was carried further, perhaps, by the ancient Incas (as shown not only by history, but also by the orientation of Cuzco itself and of the many sacred sextenary or septenary structures throughout Peru) than by any other people, except we turn to the old world. There the Chinese, whose sacred nomenclature shows either that they at one time almost completely reversed the points of the compass in their slow shifting from the west in Asia to the land they now live in as the midmost of the world, or else that they never varied an earlier conventional setting of these points according to or at least like the Babylonic system. This latter led to the well-known placement of the Babylonian and Assyrian temples obliquely to the cardinal points—that is, with the angles toward instead of the sides facing north, west, south, and east; and I think it originated—so far as exemplified in these temples—in the effort to arrange within them quarters to correspond serially and leftwardly to the six cardinal points or world regions outside of them. The reasons I assign for this may as well be briefly and simply explained here.

When a Zuñi Protopriest consecrates, or begins the planting of the father and mother seeds in the center of a corn-field, he makes a hole in the soil, usually in the middle of a circle of prayer-meal (Fig. 31). Over this he marks a cross, also in prayer-meal, the four arms of which reach out toward the four cardinal points. At the extremity of each arm of this cross, beginning with the northern (*i*, Fig. 31), he digs a planting hole. Then, moving his planting stick around and toward the left, outside of these, he digs a hole to the left of and slightly *below* (or south of) the northern hole (*v*, Fig. 31), and again moving his stick around the entire circuit, digs another hole to the right of and slightly *above* (or north of) the southern hole. Finally, moving his stick once more entirely around the circuit, he places it in the central hole.

Now, if an effort were made to construct a parallelogramic temple with quarters in it to represent, as do these seven holes, the seven regions, in which quarters ceremonial progressions or processions were to be per-

formed (as they are dramaturgically performed by the Zuñi with his digging stick and afterwards with his corn grains) from the right (or east) side leftwardly, then the result would be the placing of the parallelogram obliquely and leftwardly to a line running north and south, in order that, as I have tried to indicate by the dotted lines in the accompanying diagram, the northern quarter (*i*) might be above or truly north of the upper quarter; that the southern quarter (*iii*) might be below or actually south of the lower quarter (see and compare diagram, Fig. 31, with plan of the "ancient spaces," Fig. 32, and of Casa Grande, Pl. I).

21. In this may be seen either the origin or a development of the invariable four-fold circuit or procession four times leftwardly around the altar, shrine, or other receptacle of offerings—as a dramatic coming from or going to the six regions in succession—the four first regions being comprehended in a single circuit—as pertaining to the single plane of this world alone, whilst the visit to the *Middle* must have a circuit by itself as comprehending or representing all the rest in this world.

THE MEETING OF THE AMERICAN ASSOCIATION for the Advancement of Science was held in Rochester, New York, August 17–24. In Section H, devoted specially to anthropology, the presiding officer was Mr. Wm. H. Holmes, of the United States Bureau of Ethnology, and the secretary Rev. W. M. Beauchamp, of Baldwinsville, New York. The following are the titles of the papers read:

River Pebbles Chipped by Modern Indians.....H. C. Mercer.
Cañon and Mesa Ruins in Utah.....W. K. Moorehead.
A Few Psychological Inquiries.....Laura O. Talbot.
Indian Camping Sites near Brookville, Indiana.....Amos W. Butler.
On Some Prehistoric Objects from White Water Valley..Amos W. Butler.
Early Religion of the Iroquois.....W. M. Beauchamp.
Early Indian Forts in New York.....W. M. Beauchamp.
Ancient Earthworks in Ontario.....C. A. Hirschfelder.
Evidences of Prehistoric Trade in Ontario.....C. A. Hirschfelder.
Anvil-shaped Stones from Pennsylvania.....Dr. D. G. Brinton.
Vandalism in Yucatan and Central America.....M. H. Saville.
Ethnology in the World's Columbian Exposition.....F. W. Putnam.
Serpent Mound, Adams County, Ohio.....F. W. Putnam.
Involuntary Movements.....Joseph Jastrow.
Tusayan Legends of the Snake and the Flute People,
Matilda C. Stevenson.
Skull of a Pig with a Spear-head Imbedded.....E. W. Claypole.
Remains along White River, Indiana.....Amos W. Butler.
Earthworks near Anderson, Indiana.....Amos W. Butler.
Primitive Number System.....Levi L. Conant.

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Comparative Chronology[1] ..... W J McGee.
The Alphabet of Landa ..... H. T. Cresson.
Peabody Museum Honduras Expedition ..... F. W. Putnam.
Explorations in Copan, Honduras ..... M. H. Saville.
Aboriginal Quarries of Flakable Stone and their bearing on the question of Paleolithic Man ..... W. H. Holmes.
Copper Implements and Ornaments from the Hopewell Group, Ohio, W. K. Moorehead.
Pipestone Quarry and Lake Superior Copper Mines ..... W. H. Holmes.
Proposed Classification and International Nomenclature of Anthropological Sciences ..... Dr. D. G. Brinton.
Prehistoric Earthworks of Henry County, Indiana ..... T. B. Redding.
The So-called Paleolithic Implements of the Upper Mississippi, W. H. Holmes.
A Definition of Anthropology ..... O. T. Mason.
Pueblo Myth and Ceremonial Dances ..... F. H. Cushing.
Recently Discovered Cerebral Porta ..... C. P. Hart.
Points Concerning Fort Ancient ..... S. S. Scoville.
Prehistoric Pottery from Mound in Illinois ..... J. Kost.

The chief discussions were over the papers of Messrs. Brinton, Conant, Holmes, McGee, and Mason, inasmuch as each one of them trenched on the border of the Debatable Land.

OTIS T. MASON.

SACRIFICES TO DEPARTED SOULS IN NEW BRITAIN.—"In Duke of York Island feasts are often held in remembrance of the dead," says Rev. B. Danks in the *Journal of the Anthropological Institute*, Vol. XXI, No. 4. "On one occasion," he continues, "I saw no fewer than five pigs killed for such a feast. Prior to killing them a whole week was spent in dancing and singing from sunset to sunrise. Men and women, old and young, all joined in the dances. On the day appointed the pigs were killed and cooked whole. Before cutting them up, a man took a knife and cut loose a piece of skin, about two inches in diameter, on the fore part of the skull of each pig. He then stood up, holding an old cocoanut in his hand by the sprouts growing out of it, and calling upon the name of the deceased man said, 'This is for you;' he then struck the pig with the cocoanut on the spot where the skin had been cut loose. Each pig was thus devoted to some departed soul. This custom is called the 'Wetu.'"

[1] See pp. 327–334.

THE "MONTEZUMA" OF THE PUEBLO INDIANS.

BY ADOLF F. BANDELIER.

There is no need of proving that the name of the Mexican "Chief of Men" (Tlaca-tecuhtli) who perished while in the custody of the Spaniards under Hernando Cortés in 1520 was Mo-tecuh-zoma, literally "Our Wrathy Chieftain." Bernal Diez del Castillo, an eye-witness and the much-prejudiced author of the "True History" of the Conquest, is responsible for the corruption into Montezuma, which has since become popular and most widely known. It is interesting how that misspelling has taken hold of the public mind, how it has completely supplanted the original true orthography and meaning. Meaning even is out of place here, for, while *Motecuhzoma* is a legitimate Nahuatl word with a very plain signification, and also a typical Indian personal name, *Montezuma* has no signification whatever; and yet, in Mexico, even the Nahuatl Indians—those who speak the Nahuatl language daily—know only Montezuma and would hardly recognize the original name as applicable to him, whom they have been taught to call an "emperor."

Still, it is not so very strange when we consider that at Cozcatlan, in the State of Puebla, at least two hundred miles from the City of Mexico, the Indians gravely tell the traveler that the ruins of an ancient Indian town in that vicinity are those of the "Palace of Montezuma," where that "emperor" was "born" and whence he started out to "conquer the city of Mexico." It cannot surprise us to hear of perversions of names only. The folk-tale of the Indians of Cozcatlan (a modern tale, of course) shows how easily facts are distorted in the minds of primitive people when they do not originally belong to the circle of their own historical tradition.

In the story of Cozcatlan we have a conquest of Mexico by Montezuma from the *southeast*. In New Mexico the present century has evolved the story of the conquest of Mexico by Montezuma from the *north*. It is necessary, however, before we examine that story and its origin to investigate how the name of Montezuma crept as far north as the southwest of the United States, through what vehicles, and how far it extended its fame.

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No mention is made of Montezuma in Spanish documents on the Southwest of an earlier date than 1664, when, speaking of the (then recently discovered) ruins of Casas Grandes, in northwestern Chihuahua, Francisco de Gorraez Beaumont and Antonio de Oca Sarmiento speak of those buildings as the old "houses of Montezuma." Such an utterance, coming from Spanish officers of high rank, shows that already then the name Montezuma had become, in the minds of the Spaniards themselves, confounded with migration-tales of Indian tribes of a very ancient date, and that those tales apply, not to the unfortunate war-chief of the time of Cortés, but to one of his predecessors in office, Motecuhzoma Ilhuicamina, who commanded the forces of the Mexicans in the early part of the fifteenth century, according to the still doubtful chronology of the ancient Mexicans. The confusion between those two personages had already been procreative of a mythical Montezuma in the minds of the educated people. Is it to be wondered at if that mythical figure took a still stronger hold on the conceptions of the simple Indian?

Genuine folk-tales of the Chihuahua Indians are reported at an early date by Captain Gaspar Perez de Villagran, one of the officers of Juan de Oñate, when the latter colonized New Mexico in 1598. The metrical chronicle of Villagran was printed in 1610, and it mentions the tradition of a migration of tribes from the north, during which migration they divided into two bands. But no mention is made of the name of Montezuma as connected with Indian folk-lore of northern Mexico; nor do the Jesuit Fathers, who studied the Indians of all the States north of Jalisco as early as the latter part of the sixteenth and the beginning of the seventeenth centuries, and who consequently enjoyed the advantage of holding intercourse with those natives while the latter were still in their primitive condition, make any mention of a Montezuma lore. Ribas, whose classical work on Sonora and Sinaloa appeared in 1645, is absolutely silent on that subject, although he makes frequent and detailed mention of the creeds, beliefs, rites, and traditions of nearly all the tribes that inhabited those two states of the present Mexican republic. In none of the reports on the New Mexican Pueblos, as far as we have them previous to 1680, does the name of Montezuma appear in connection with those aborigines. Hence it may safely be assumed that the Montezuma story is, in the North American southwest, as much of an importation from the south and subsequent

transformation, as it is clearly an importation and transformation, though imported thither from the northwest at the village of Cozcatlan.

Every Spanish expedition that penetrated to the northward had in its company Indian followers as servants and sometimes as interpreters, since dialects of the Nahuatl tongue prevailed as far north along the Pacific coast as Sinaloa. Among natives from the interior of Mexico the name Montezuma was, of course, a household word already in the second generation, for the fame of the war chief and of his tragical end increased in proportion to distance from the time as well as from the scene of his career. In that second generation Motecuhzoma was already practically forgotten, and Montezuma remained in the mouths of the people as a hero. An Indian hero very soon becomes a mythical personage, and what with confuse reports of old traditions and folk-tales current among nearly every tribe, Montezuma could not fail to become a figure which, in course of time, shone among the folk-lore of nearly every tribe. It may be asserted that the New Mexican Montezuma is probably the latest of these numerous local adaptations and infiltrations into the mythical history of the Mexican and Southwestern aborigines.

At an early date confuse notions of the geography even of central Mexico took root among the inhabitants of the New Mexican pueblos. When Coronado evacuated New Mexico in 1542, some Indians from the valley of Mexico remained behind at one of the villages of Zuñi. Forty-two years later Antonio de Espejo visited the Zuñis and found three of these Indians still alive. He also heard of a great lake on the shores of which were important settlements of sedentary Indians, all of which were rich in gold and precious stones. That lake was said to be at least several moons distant from Zuñi. It is easy to recognize in those wild statements a distorted picture of the home of the Mexican Indians. Combining it with the name and fame of Montezuma, we obtain a basis upon which a well conceived Indian folk-story might be established.

The Montezuma story circulated slowly among the New Mexican tribes. During the interrogatories of Indian prisoners taken before Governor Don Antonio de Otermin in the autumn of 1681, when the latter made his unsuccessful expedition into New Mexico as far north as Cochití, quite detailed information was elicited as to the original causes of the great Insurrection of the Pueblos. The witnesses examined were Indians who had not been in almost daily

contact with the Spaniards and their Mexican Indian servants, and not one of them spoke of Montezuma, whereas the names of specific Pueblo deities, such as Caudi, Heume, and Tilim, were mentioned as those of gods appearing to Popé in the estufa of Taos. Only the Indians from the pueblos around Santa Fé spoke of Montezuma, connecting his name with that of Pose-yemo (Pedro Lezemu in the defective copy of the journal of the siege of Santa Fé of 1680, which copy was made in the last century by order of the Spanish crown), a historical personage of Tehua folk-lore, also called Pose-ueve, and known to the Keresan or Queres tribes of New Mexico under the name of Push-ay-a, to the Zuñis as Pó-shai-an-k'ya, and to the Jemez as Pest-ia-sod-e. The prisoners on the 20th of August, 1680, treated of Pose-yemo and Montezuma as of two distinct personages though related. In this century they have gradually become confounded.

Hardly anything is heard of Montezuma in New Mexico during the last century; in fact, until the time of the Mexican war of 1846. Farther south, however, it became customary to attribute the origin of every notable ruin, about the past of which nothing was known, to Montezuma and to the hosts which he was said to have led to the south. Casa Grande, on the Gila river, escaped from this fate. Already Father Kuehne (Kino) heard from the Pimas that the erection of that building and of the cluster of houses surrounding it was due to a chief named Siva, who came from the north, and although Father Sedelmair in 1746 incidentally refers to the Montezuma story in connection with Casa Grande, there is a decided inclination toward attributing the construction of those edifices to some fraction of the Moki tribe rather than to the Nahuatl of Mexico. It may be noticed here without impropriety and without any danger of misinterpretation that it is a singular coincidence to find early explorers mentioning the Moki as the possible founders of settlements so similar in architectural type to Casas Grandes in Chihuahua as the Casa Grande is, when subsequent investigation tends to prove that the Moki belong to the same linguistic stock as the Nahuatl, the Pima, and the Opata of Sonora. I mention this merely as a coincidence, not as a historical indication.

At the present day, when one inquires of the Indians at El Paso del Norte about "ruinas," they fail to understand him and reply that there are none; but if he asks concerning "Montezumas," they will at once point to the spots where mounds covered with pottery denote the former existence of permanent aboriginal build-

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ings. The same is the case along the course of the Casas Grandes river from the Hacienda of San Diego to Ascension. Every mound, every ancient wall, is not a "ruin" but a "Montezuma" in the mouths of the people. The tribes who inhabited that section at the time it was first discovered, the Sumas, also roamed about El Paso, and were even located thereabout by the Spaniards during the last century. It is, therefore, likely that through them the original Spanish mistake of attributing the erection of Casas Grandes to a mythical Montezuma (in the absence of any other aboriginal tradition or folk-lore touching their origin) became circulated, and that thus the personal name was transformed into a designation for a certain class of ancient vestiges.

We now come to the time when the Montezuma story assumed a prominent position among the New Mexican Pueblos. The manner in which this happened is not devoid of interest.

In the year 1846, when war between the United States and Mexico was imminent, a singular document was concocted (according to its tenor, at least) in the City of Mexico. It is written in Spanish and was, to my knowledge, never printed, but exists in several manuscript copies in New Mexico. It purports to be a "History of Montezuma." Beginning with the folk-tale current among the Tehuas about their hero god Pose-yemo or Pose-ueve, it applies that part of the story relating to the latter's childhood to the childhood of Montezuma, and then goes on to relate the career of the latter, of his sister and mother, etc., until it makes of him a conqueror of Mexico. There Montezuma becomes connected with the Malinche. What the Malinche was is well known. The name itself is a corruption of the Spanish name Marina by the Nahuatl, who, not having the letter "r" in their alphabet, substituted always the letter "l," thus making "Malina" out of "Marina." Marina was the interpreter *en chef* of Cortés during his conquest of Mexico. The document cited makes of the Malinche a daughter of Montezuma, and, after bringing in Cortés and his conquest and victory over Montezuma, concludes by marrying the Malinche to Cortés, and by representing New Mexico as a part of the dower which the Indian maiden brought to her Spanish husband. Such a document, manufactured at a time when an American invasion of New Mexico was apprehended, written at the City of Mexico and circulated in every New Mexican pueblo that could be reached, is plainly what may be called a "campaign document," conceived in view of strengthening

the claims of Mexico upon New Mexico in the eyes of the Pueblo Indians and refuting anything to the contrary that might be anticipated from the side of the United States. It is written in a style peculiarly within the grasp of the Indian, it being Spanish after the fashion in which the Pueblo Indian uses that language in conversation. Whether written in New Mexico and only dated from the capital, or written at that capital, it is certain that the author deserves great credit for the shrewdness with which he has adapted both story and style to the imagination and power of understanding of the aborigines. Since the circulation of that document the story of Montezuma has become stereotyped in the mouths of many Pueblo Indians, and when interrogated by tourists and ethnological volunteers they repeat it with greater or less precision.

On the surface it would appear that the "History of Montezuma" just spoken of cannot have been written anywhere else than at the City of Mexico, since it seems to have been plainly a political instrument in view of an impending invasion. Still, it is not impossible that it was a product of New Mexican ingenuity. There was material for it in one of the pueblos of that territory, that of Jemez.

For many years past it has been known that the Indians of Jemez had in their possession a printed book, which they carefully concealed and of which it was stated that it contained a "History of the Pueblos," profusely illustrated. I never succeeded in seeing it, but the Most Reverend Archbishop of Santa Fé, during one of his official visits to Jemez, obtained permission to peruse the mysterious volume. It proved to be, as we ascertained by comparing it with a copy in my possession, a copy of the Letters (*Cartas*) of Cortés edited by Lorenzana and illustrated with pictures of Mexican costumes, etc. From this book, the existence of which was known to all the Pueblos and about the contents of which they had been partially informed, it would have been easy to gather material for the "History of Montezuma" of 1846, and it is not unlikely that it has been the source of the latter, except of the introductory portions, which embody a genuine tradition of the Tehua Indians, which was easy to obtain from any one of the more communicative members of that or of any neighboring tribe.

The Montezuma of New Mexico is, therefore, in its present form a modern creation. The Indian—that is, the Indian of higher standing in his tribe, the wizard, for example—discriminates between the modern imaginary figure and the historic gods of his own,

and, while he may repeat the Montezuma tale to an unsophisticated listener, fresh from the outside world, with the greatest apparent sincerity, he inwardly thanks that modern story for the service it renders him in screening his own sacred traditions from pryers into secrets which the Indian considers as his own and no one's else. Younger people may repeat the Montezuma tale in all candor, simply because they do not yet know better; but, as it is, it stands as an importation first, a modern fabrication or compilation next, without the slightest connection whatever with original mythology and traditional history of the North American southwest and northern Mexico.

Among the many vehicles that contributed to popularize the name of Montezuma in these regions the dance of the "Matachines" should be mentioned. It was introduced among the Indians of central Mexico in the sixteenth century as a part of the semi-religious theatrical performances, by means of which the Franciscans gradually superseded the idolatrous dances of Indian paganism. In it appear two prominent characters—the "Monarch" (*el Monarca*) and, as solo-dancer, the Malinche. With the idea of the Monarch the recollection of Montezuma became intimately connected. When the Matachines were introduced into New Mexico I am unable to tell, but certainly, at latest, during the 18th century. The relations, which in that dance are indicated as between the Malinche and the Monarch, bear a striking analogy to those represented in the "History of Montezuma" above mentioned.

It is also to be noticed that several villages—above all, that of Pecos—have been represented in this century as the birthplace of Montezuma. This seems to give color to the assumption that Montezuma was indeed a real character of New Mexican aboriginal tradition. If we compare, however, the genuine tradition of Pose-yemo among the Tehuas with the Montezuma tale, we see at a glance that the latter is only an adaptation, spun out to much greater length and carrying the career of Pose-yemo into lands with which no New Mexican Indians had the least intercourse previous to the coming of the Spaniards. According to the folk-tale of Pose-yemo, the latter was a great wizard, born at the now ruined village of Pose-uing-ge, above the hot spring of the Hon. Antonio Joseph, in northern New Mexico. He performed the usual wonderful tricks attributed to a powerful Indian shaman, and, after rendering his people very prosperous and powerful, disappeared at his

native place "in the course of human events." In regard to the statement that Montezuma was born at Pecos, it must be remembered that the Pecos were a branch of the Jemez, and the existence of the book spoken of at the latter village, coupled with the intimate relations between the two tribes, contributed to create and foster the notion that Montezuma had been a wonder-child of the Pecos pueblo.

[The above article was written by Professor Bandelier while on board the steamship *San Juan*, off the coast of Tehuantepec, en route to Bolivia, his new field of investigation.—EDITOR.]

SOCIAL STATUS OF PUEBLO WOMEN.—The social corner-stone (of the Pueblos) is not the family, but the clan. Husband and wife must belong to different gentes, and the children follow the clan of the mother. The Pueblo has never used his wife as a pack-beast. He is not hen-pecked, but just, and even finds no shame in "toting" the baby upon his back all day when he has no more essential duty. The spheres of the sexes are clearly defined, but manfully. The woman is complete owner of the house and all it contains save his personal trinkets; and she has no other work to do than housework, at which she is no sloven. Should her husband ill-treat her, she could permanently evict him from home, and could be upheld in so doing. The man tills the fields, and they are his; but after the crops are housed she has an equal voice in their disposition. The live stock is, of course, his; but he will seldom sell an animal without consulting his wife. The family relations are very beautiful. Conjugal fidelity is as general as with us. The Pueblo was a prehistoric monogam, and punished unfaithfulness with death; and it is doubtful if any American community can show a less percentage of loose women.—(C. F. LUMMIS in September *Scribner.*)

"DER YUMA-SPRACHSTAMM nach den neuesten handschriftlichen Quellen dargestellt," by Albert S. Gatschet, has been issued as a *Separat-abdruck* of the "Zeitschrift für Ethnologie." In addition to considerable information of an ethnographic and descriptive nature regarding the various Yuman tribes, this pamphlet of 18 pages contains comparative vocabularies of the Havasupai, Maricopa, and Mohave dialects, and is the fourth of the author's Yuma series.

COMPARATIVE CHRONOLOGY.[1]

BY W J MCGEE.

I.—*Natural Time-Units.*

The earth rotates on its axis, and day is born of the night and runs its course of sunshine; and it is a "sun" or day. The earth revolves about the sun, and summer is born of winter and gradually cools again; and the cycle is a year. These are the solar periods of the savage and the philosopher.

Our satellite revolves about the earth, and its light waxes and wanes and then goes out; and from dark to dark is a "moon" or lunation of 29½ days. This is the lunar period of the nomad and the astronomer.

The earth and moon pursue their paths through space, and sometimes the moon passes athwart the face of the sun while again the earth's shadow darkens the moon, and there is an eclipse; now while the eclipses of any year do not correspond with those of the next year or of the last, yet earth and moon are so related in space that after 223 lunations, or about 18 years, the cycle of eclipses is repeated; and this eclipse cycle is a Chaldean saros.[2] When the earth completes a revolution about the sun and four seasons have passed, the place of the moon is not the place occupied at the beginning of the year, for the lunar and solar cycles are not commensurable; but, as the revolutions run, the new year and new moon first diverge and then converge until at the end of 235 lunations, or 19 years, they nearly coincide again; and this cycle is the tchang of China or the Metonic cycle of ancient Greece, the source of our Golden Number and the basis of the ecclesiastic "movable festivals" of modern times. At the end of four of these 19-year periods the moon returns still more nearly to the initial place, and this longer

[1] Read before section H of the A. A. A. S., at Rochester, August 22, 1892.

[2] Modern observation, combined with the Newtonian theory, has corrected this and other primitive empiric periods.

cycle of 940 lunations or 76 years is the Callippic cycle of ancient Greece, known long before in China. Then as tchang succeeds tchang and generations of men grow old and die, the moon oscillates about the new year until the satellite has circled the earth 7,421 times and 600 years have come and gone, when the initial relation is so nearly restored that only refined observation or correct theory can detect the difference; and this long cycle is the Chaldean naros. But even the naros is not the end; for after 243 tchang, or 57,105 lunations, or 4,617 years, the old positions are almost exactly restored and also conjoined with an arbitrary time-unit of 60 days;[1] and this longest cycle of primitive observation, at the same time one of the most marvelous of human achievements and the most significant historical evidence of human antiquity, is the Chinese Great Year. These several cycles are the lunisolar periods on which most ancient and many modern calendars are based.

The earth rotates as it revolves about the sun, and the synodic year beginning at noon ends at nightfall, for the periods of rotation and revolution are not commensurable; after four years have passed the star rising with the sun on the new year is near the rising sun on the second day of the year, but it is not until 1,461 winters have melted into summer that the sunrise star of a full-day calendar again rises with the sun on new year's day; and this is the Egyptian Sothic cycle. The earth bulges at the equator and the equatorial protuberance is attracted by sun and moon in such manner as slowly to shift the seasons as the years come and go until winter becomes summer and summer winter at given dates on each portion of the globe; this secular shifting of the seasons, or precession of the equinoxes, waxes and wanes again through a cycle of over 25,000 years[2] and forms a Platonic year. These cycles may be called siderosolar periods, since they are determined through the aid of the fixed stars.

The several cosmic movements and the solar, lunar, lunisolar, and siderosolar cycles through which they run yield the so-called

[1] According to Houzeau: Bibliographie générale de l'Astronomie, par J. C. Houzeau et A. Lancaster, tome premier, première partie, 1887 (Introduction), p. 95.

[2] The mean cycle is 25,694.8 years, with a secular inequality of 281.2 years, as computed by Stockwell: Secular Variations of the Elements of the Orbits of the Eight Principal Planets (Smithsonian Contributions to Knowledge), 1872, pp. xii, 175.

"natural time-units," and represent the bases of calendars and chronology. Summarized in tabular form they are:

Solar period.....	Sun or day.
" "	Summer or year, 364¼ days.
Lunar period	Moon or lunation, 29½ days.
Lunisolar period....	Saros (Chaldean eclipse cycle), 18 years, 223 lunations.
" "	Tchang or Metonic cycle, 19 years, 235 lunations.
" "	Callippic cycle, 76 years, 940 lunations.
" "	Naros, 600 years, 7,421 lunations.
" "	Chinese Great Year, 4,617 years, 57,105 lunations.
Siderosolar period ..	Sothic cycle, 1,461 years.
" " ..	Platonic year, 25,694.8 years.

All of these cosmic cycles were observed by primitive peoples (though the precession of the equinox was perceived only as a linear movement). The rudest savage regulates his activities and reckons his journeys by suns; all pastoral nomads reckon time by moons, and some develop lunar calendars; the fruit-eater and the forerunner of the farmer reckoned by the march of the seasons, and various groups in different parts of the world developed solar calendars. The night-watching herdsmen of the Chaldean plains revered new moons and marveled at eclipses for unnumbered generations until they established the saros and naros; the flood-taught fellahin of the Nile immortalized the annual inundations in traditions and hieroglyphs, and full 5,000 years ago wrought out the sacred Sothic cycle of a millennium and a half, and their sages measured a part of the Platonic precession; untold millenniums past the patient rice-growers of the Yellow river watched the wanderings of earth and moon until they succeeded in establishing, long before the beginning of our era, a cycle similar to that forming the basis of our own ecclesiastic calendar, and a far greater cycle approaching in duration the entire term of extant written history; even the ancient Aztecs of our own continent had, according to Houzeau, a lunisolar calendar more exact than the Julian calendar.[1]

The shorter of these cycles are recognizable in the childhood of individuals and of races; the longer are so great as almost to baffle realization. They may be made appreciable by comparing them with familiar space units: Let a day be represented by a thick

[1] Bibliographie générale de l'Astronomie, op. cit., p. 92.

pen-stroke, a thirtieth of an inch across; then, a lunation will be an inch, a year will become a foot, a saros will extend over a rod, and a Callippic cycle will be longer than a surveyor's chain. On the same scale, a naros will stretch into the conventional rifle-shot of 200 yards, the Sothic cycle will be over two furlongs, and the Chinese Great Year nearly a mile, while the Platonic year will become five miles.

Such are the natural units by which mankind have ever sought to measure time.

II.—*Artificial Units and Eras.*

Time is commonly classed as one of four fundamental conceptions to which all other conceptions may be reduced; for Energy is manifested through Matter disposed in Space and acting through Time. But, on analysis, time (and perhaps space) would seem ancillary to energy, since the conception of motion involves not only the spatial quantity through which the points or particles move, but a correlative quantity extending from the beginning to the end of the movement. If this is so, the idea of time springs from the sequence of events or stages in that movement of points or particles which is comprehended under the term energy. Then time may be characterized as the *order* and space as the *direction* of cosmic energy, and, so far as this definition is concerned, it boots not whether matter and energy are essentially one or intrinsically distinct.

It is important that the conception of time should be clearly defined; for by definition it may be either excluded from or included within the domain of science. Poets and dialectic philosophers teach the infinite uniformity of time just as they once taught the infinite divisibility of matter, and thus relegate the conception to the realm of the supernal, far beyond the reach of actual experience; but, if the conception can be reduced from the ideal to the real and definitely correlated with the more exact and hence more refined conceptions concerning energy and matter, a vantage point for research will be gained. In poesy and dialectics time is absolute, extra-physical and unknowable; as characterized above, time is relative, a manifestation of energy or matter-energy, and a subject of exact knowledge. The dialectic conception of time is hazy and its origin is shrouded in mystery; under the physical characteriza-

tion the conception is definite and stands for actual experience, individual and inherited—it is a composite picture, made up of a vast series of actual percepts and concepts. In lax ideation time is the perfect standard of which theorists dream; in exact thought orbital revolution is the gold and axial rotation the silver of the cosmic bank of time, but the measures are neither commensurable nor constant, and all other values must be adjusted to them arbitrarily. So the conception of time may be defined as the sum of experiences concerning the order of motion, *i. e.*, concerning the sequence of position.

Conceiving time as ancillary to energy or matter-energy, and thus as an expression of the motion of points, particles or masses, it may be relatively measured in different ways, depending on the nature of the motion: It may be measured by linear motion, and indeed has been so measured by observation on falling bodies and by the clepsydra and the hour-glass; it may be and is commonly measured by rhythmic or reciprocal motion, as in the pendulum; and it may be measured by cyclic or rotary motion, and this has been done from the beginning of human existence through observation on the sun, moon, and stars. Of these methods the last is the best, and the first the least useful; linear motion is neither uniform nor persistent, rhythmic motion is more orderly and persists longer, while cyclic motion is far more orderly and persistent than either. Yet even cyclic motion is variable, since orbits are eccentric and one part and another of the cosmic mechanism thus runs fast and slow alternately; there is indeed no uniform process in nature; and the measure of time is simply the aggregate or mean of certain observed motions expressed in arbitrary terms.

In measuring time by cyclic motion a difficulty arises with the effort to fix arbitrary limits for the limitless cycles; and moreover the cycles themselves are in some degree illusory: To an observer on the moon the shadow of the Andes would indeed sweep across the face of the earth, but meantime the body of the earth would move many times further; to an observer on the sun, the moon would, it is true, stand sometimes on this side of the earth, sometimes on that, but meantime both would move many times the length of the minor orbit, and the satellite would seem simply to pursue a serpentine path; and an observer at a thousand times Neptune's distance might see the entire solar system spin through space at a rate far exceeding that of either satellite or planet. Yet

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the difficulty of limiting the cycles is measurably overcome by means of conjunctions or approximate conjunctions among the cosmic bodies; and it is thus that the so-called natural units of time have been developed.

The chronologer takes his primary units from the astronomer; but since there are no aliquot parts in nature he is fain to adjust them to his needs artificially, and so the rotation period of the earth is divided into hours, and these into minutes and again into seconds, and multiplied to form the week; the lunation is transformed into a month; the revolution-period of the earth is sometimes lengthened, sometimes shortened, and converted into a civil year; and the years, civil and synodic, are grouped into natural cycles and artificial eras. So calendars and chronologic eras are developed; and it has come about that ambitious Man has so far arisen above simpler Nature that some of the natural time units are forgotten—modern events are dated by artificial eras in terms of a calendar which most users could not explain without recourse to the dictionary or encyclopedia.

History is a resultant of two forces, one objective, the other subjective—the first is the natural march of events, the second is the series of impressions stamped in the mind by successive events. So history clusters about events of real or fancied import. Among savages, days are reckoned from the great flood and moons from the fear-inspiring eclipse; among barbarians, years are reckoned from the cold winter or the great famine; with the beginning of national organization time is reckoned from the bloody war or the birth of the king, and in a higher stage of intellectual development the reckoning is based on dynasties and the birth of nations; while most of the current bases for historical reckoning are of religious origin. In this way written history is marked by episodes which are grouped into eras, varying with nations and religions, yet commonly reducible to the uniform standard of the chronologer—the historian takes the terms of the astronomer and chronologer as a warp and fills them with the woof of events current and past and thus weaves the fabric of history.

A typical historical era is that of American independence, and in the early days of the republic it was not uncommon to find documents inscribed "In the year of Our Lord seventeen hundred and ninety-two, and of American Independence the sixteenth;" and another typical era is that of the discovery of America by Columbus.

In Persia the current chronology rests on the era of Yezdegird, or Persian Era, and in most Mohammedan countries on the Era of the Hegira, both beginning a millennium and a quarter past; the most widely recognized chronologic period is the Christian Era, now of nearly two millenniums, and chronologers recognize two slightly longer periods in the Augustan and Julian eras; astronomers find the Era of Nabonassar, of which this is the year 2,638, an exceptionally convenient datum point for time-reckoning, while chronologers frequently use the nearly coeval Roman Era and period of the Olympiads; the modern Chinese historian dates by dynasties, but the chronologers run back to the Era of Yao, beginning 4,288 years ago, while the Hindu chronologer reckons from the beginning of the Fourth Era, or Kali-yug (in a series of which the first three are partly fabulous), and of this era 4,992 years are gone; the Jewish Era began 5,651 years ago, and this year, 1892 A. D., is the year 5,895 A. M., or the 5,895th year in the Era of Creation, according to the biblical genesis as interpreted by Ussher; and the longest of the definite historical eras now currently recognized is that of the Greek Church, or Era of Constantinople, beginning 7,400 years in the past.

Such are among the historical eras by which men have measured the flight of time. They may be summarized as follows:

Era.	*Origin.*	*Present length.*
Era of American Independence[1]	A. D. 1776	116 years.
Columbian Era[1]	1492	400 "
Persian Era, or Era of Yezdegird	632	1,260 "
Era of the Hegira[1]	622	1,270 "
Christian Era[1]	....	1,892 "
Augustan Era	B. C. 27	1,918 "
Julian Era	45	1,936 "
Era of Nabonassar[1]	747	2,638 "
Roman Era	750	2,641 "
Olympiads	776	2,667 "
Era of Yao[1]	2397	4,288 "
Kali-yug (Fourth Era)[1]	3101	4,992 "
Jewish Era	3760	5,651 "
Era of Creation (Ussher)[1]	4004	5,895 "
Era of Constantinople[1]	5509	7,400 "

These historical eras, like the natural time-units, may be made appreciable by comparison with familiar space-units. If a day is

[1] Represented graphically in the accompanying plate.

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represented by a thirtieth of an inch and a year by a foot, then the Era of American Independence will be represented by the width of a street, and the Columbian Era by a block; on the same scale the Era of the Hegira will be a quarter of a mile, the Christian Era three furlongs, the Era of Nabonassar half a mile, the Era of Yao seven furlongs, the Kali-yug a scant mile and the Era of Creation a mile and a furlong, while the Era of Constantinople will stretch to nearly a mile and a half.

III.—*The Biotic Ages.*

In the beginning of life on the earth the organisms were simple and lowly and left little trace of their existence.

In the second day of the biotic genesis, the feeble stream of life divided into plants and animals; some organisms developed stems, leaves and roots, and others made for themselves stony structures such as the cell-walls and calyces of corals and the shells of foraminifera; and many of these structures are entombed among the older rocks of the earth.

Next the shell-fish and their kindred came to prevail, and the vital energy of the planet was chiefly spent in maintaining their supremacy; and this was the day of the mollusk.

In the fourth stage of life on the earth the external stony structures of the prime gave way to internal bony structures, and the vertebrates came into being and soon prevailed throughout the seas; and it was the age of fishes.

Then the seas shrank and the islands grew into continents, and land plants were developed and multiplied until they dominated the earth to the extent that their fossil remains form the fuel of the present; and this day of the plants marks the decline of the reign of the sea and the beginning of the supremacy of the land.

When the sun of the plant day set the power of the plants was lost forever, for with the next age in the genesis of living things birds and beasts were born on the land as well as great reptiles in the sea, and all other things became subordinate to them. The day of land animals was long, and its hours are marked by the rise and decadence of one and another dominant type, each more perfectly adjusted to its surroundings than the old, and each dominating its province or the entire earth throughout its brief ascendancy. There was the hour of the winged reptiles, followed by that of the toothed

birds, and under their reign the trees ceased to live unto themselves but bore fruit to tempt the flying animals, that their seeds might be scattered; there was the hour of insects and insect-eaters, during which bees and beetles fertilized the forerunners of the flowering plants whereby vegetal vitality was in part diverted to the production of flowers and perfumes to gratify animal senses; there was the hour of the gigantic herbivores and of the huge carnivores that feasted on their flesh, and in this hour brute strength prevailed; there was the hour of the feathered bird in the forest and of the timid antelope and the slender gazelle on the plains, and in this hour fleetness prevailed; there was the moment of the American buffalo, during which he multiplied into myriads only to melt away before a changed condition; and the other hours and moments were marked by successive generations of living things, each better than the last. So the animal day was made up of a succession of hours, sometimes serial, sometimes overlapping, but all incommensurable; each hour was characterized by a distinctive vital type, once dominant but now subordinate or gone never to return; and each hour is recorded in the fossils stored up in the rocks. Thus ended the sixth day in the genesis of life.

With the morning of the seventh day cunning appeared, and thenceforth the race was not to the swift nor the battle to the strong; for this was the day of intellect, budding in the beast, blooming in the savage, and fruiting in enlightened Man.

So the record of life read from the fossils entombed in the rocks of the earth falls into a series of biotic ages, or ages characterized by distinctive organic types. This record is the subject-matter of the science of paleontology, and the basis of geologic classification; but it cannot be reduced directly to cosmic or historical units. Yet the record proves that time is long. The improvement of a breed or strain of stock or the development of a new flower or fruit requires generations of culture; the development of a new species without art must require a vastly longer period; and the transformation of organic types upon the earth without the aid of intelligence must involve the birth, growth and death of an incalculable number of generations. Moreover, there is reason for holding that the evolution of organisms has proceeded with ever-increasing rapidity since life came to be on the earth, so that the modern rate would give too low a measure for past time.

Estimated by generations, each day of the biotic genesis is long,

too long for ready realization; but the rhythmic life-waves are not commensurable with the revolutions of cosmic bodies nor with the rotation of planets, and there are no means of directly reducing any biotic age or lesser period to chronologic units. So while the biotic ages are vast, they cannot be expressed in the quantitative language of graphic representation, and may not be compared with space units.

IV.—*The Geologic Periods.*

The sun shines on the earth and the waters of sea and land are evaporated to gather in clouds about the mountain tops and over the plains, and then to return to earth in showers and rain-storms; and as the drops gather into rills and rivulets and eventually into torrents, they collect grains of sand which are washed down the slopes and finally swept into the sea. After a myriad storms and floods the sand grains on the sea bottom are so many as to form a thick and wide-spread deposit; and this is a geologic formation, and the days and years of its accumulation are a geologic period.

As the sand grains are gathered by the storm, gullies are formed, and these are gradually widened into channels in which not only storm-born torrents but peaceful streamlets run; and after a myriad storms and floods the channels expand into great valleys; and the days and years of the scooping out of these valleys make up a geologic period.

Now while the rainfall and the removal of the sand grains result from the sunshine and thus follow the stately march of the daily suns and yearly springtimes, the movements are not commensurable, and no given formation or system of valleys can be correlated with any given cosmic cycle. Yet the mean rate of rainfall has been measured and the mean rate of sand-wash has been computed in many lands, so that the length of the period required for the accumulation of any formation may be estimated, albeit arbitrarily. In this way the time required for the accumulation of the multitude of formations of which the rocks of the earth are composed may be estimated in terms of the natural time-units, and thus in terms of the calendar; and such estimates repay a part of the debt which geology owes to biology for its primary classification, in that they yield a basis for the approximate mensuration of the biotic stages. Moreover the longest of the cosmic cycles is of use in reducing geologic periods to cosmic units; for the Platonic year, like the

annual revolution, has its winter and its summer, and there is reason for supposing that these secular seasons, alternating in each hemisphere at intervals of about 13,000 years, may so modify evaporation, rainfall and snowfall as to yield a record of their recurrence.

The latest definite formation with which American geologists have to deal is a glacial deposit margined by the great terminal moraine stretching from Long Island by way of Cincinnati and Chicago to the international boundary near the base of the Rocky mountains. The antiquity of this deposit, measured by the magnitude of the channels carved within it through the work of rains and rivers, has been variously estimated at from 5,000 to 50,000 or more years, but the later estimates are from 5,000 to 10,000 years, the last and probably the best (recently made by N. H. Winchell) being 7,800 years.[1] On comparing this estimate with the march of the secular seasons a remarkable coincidence is observed; for, since the longitude of perihelion is now 99° 30′, the middle of the last Platonic winter (which is now just begun in the southern hemisphere) occurred about 7,100 years ago. This coincidence at once strengthens the suggestion of interdependence between cosmic and terrestrial conditions, and affords a basis for comparing the natural time-units of the astronomer with the semi-arbitrary periods of the geologist; and so the date of the last ice invasion recorded in the moraine-fringed glacial deposit may provisionally be fixed at 7,100 years ago.

The next older formation with which American geologists are able definitely to deal is the Columbia formation and a coëval glacial deposit not margined by terminal moraines. All competent geologists who have studied these early deposits in connection with those of the later period (including Chamberlin, Gilbert and Salisbury) are agreed that the earlier is many times the older; that if the antiquity of the moraine-margined deposit is represented by unity, the antiquity of the Columbia formation and its correlative glacial deposit must be expressed by two figures. The estimates run from 10 to 100, the mean being about 20 or 30. Now another noteworthy coincidence between cosmic and terrestrial dates is found in this relation; for some 200,000 years ago, or about 28 times further in the past than the date fixed for the last ice invasion, the Platonic winter occurred in the northern hemisphere, and moreover the

[1] American Geologist, vol. X, 1892, page 80.

eccentricity of the earth's orbit was so much greater than now that the conditions for ice accumulation were much more favorable than at any time since or ever before. In this way the supposition that the climate of the earth and the relative positions of the cosmic bodies are inter-related is again strengthened, and at the same time another conjunction between incommensurable cycles is afforded. So the date of the Columbia formation and of the ice invasion to which it is ascribed may be fixed tentatively at 200,000 years ago.

There is a third American formation so conditioned as to yield an exceptionally satisfactory measure of its antiquity; this is the Lafayette formation of the Atlantic and Gulf slopes. Measured simply by the degradation of valleys, this formation would appear to be a thousand times older than the Columbia, but, allowing for certain known differences in attitude of the land with respect to the sea, the ratio may be diminished to 1 : 50. Since in this case no means of applying a cosmic measure has been found, this ratio may be accepted as expressing the relative antiquity of the two formations. Now the Lafayette formation apparently belongs to the Pliocene series of paleontology, or to the seventh or eighth place in a scale of 10 divisions in the geologic group called Neocene, while the Neocene is commonly estimated to be somewhat shorter than the Eocene; and thus the Lafayette formation yields a basis for estimating the period covered by the Cenozoic Age of paleontology. Reducing these estimates to a common standard by means of the significant relation between Platonic years and glacial periods, the date of the Lafayette formation may hypothetically be fixed at 10,000,000 years in the past, while the duration of the Neocene and Eocene respectively will become 40,000,000 and 50,000,000 years, and the beginning of the Cenozoic will be carried back to over 90,000,000 years ago.

Beyond the Cenozoic the data for estimating the geologic periods either relatively or in terms of years are vague, yet many geologists have made the attempt; a conservative relative estimate is that of the venerable Dana, who reckons the Cenozoic, the Mesozoic, and the Paleozoic as far back as the Silurian at respectively 1, 3, and 12. Now the Silurian cannot be far from the middle of the Paleozoic; while beyond lies the Agnotozoic, or age of unknown life—the first day in biotic genesis—which Van Hise and Chamberlin conceive to be fully as long as all the rest of geologic time. So, again reducing the great geologic periods to chronologic units by

means of the provisional measures already adopted in connection with the estimates of Dana and Van Hise (in which due weight appears to be given both to the greater rapidity of physical process and the less rapidity of biotic process in the early ages), the Mesozoic may be assigned a value of nearly 300,000,000 years, while the Paleozoic must be put at not less than 7,000,000,000 years; and this is but half of the time with which the geologist is concerned.

Such vast periods are beyond definite realization; but they may perhaps be made appreciable by comparing them with familiar space units: Let the thirtieth of an inch be a day and let a foot stand for a year; then the remoteness of the last glacial period will be represented by nearly a mile and a half, that of the Columbia formation by a day's drive of about 40 miles, and that of the Lafayette formation by a trans-Atlantic voyage of 2,000 miles; on the same scale the length of the Cenozoic will be two diameters and that of the Mesozoic two circumferences of the earth, while the Paleozoic will be represented by a line long enough to 50 times encircle the globe.

These are the units used by the geologist when he ventures to measure the periods of world growth in terms of cosmic cycles and calendars; but the reduction involves so many unmeasured factors that the conservative student essays it only by way of illustration. The astronomer determines a cosmic cycle with a "probable error" which is commonly a minute fraction of the cycle; the engineer builds a bridge to withstand a strain 3 or 6 or 10 times greater than that to which the structure will actually be subjected, and calls the exponent of the ratio between the calculated strength and the anticipated strain a "factor of safety;" but so uncertain are the relations between the incommensurable season and storm-wash that the estimates of the geologist are subject to a correction far larger than the "probable error" of the astronomer, even beyond the "factor of safety" of the engineer, and moreover this correction—which, unlike that of the engineer, may be either plus or minus—grows with the remoteness of the periods estimated. The geologist's "factor of safety" in estimating the post-glacial period may be but 3 or 4 (*i. e.*, the period may be either 3 or 4 times longer or only one-third or one-fourth so long as the average estimate), yet the estimates of the post-Columbia, the post-Lafayette, the Neocene, the Cenozoic, and each longer period and age require progressively increasing allowances for possible error. Probably the most cautious geologist will be content with a "factor of safety" beginning at 4 for the last

and shortest period and raised to successively higher powers with each successive period and age counted backward into the past, using the second power (16) for the Columbia, the third (64) for the Cenozoic including the Lafayette, the fourth (256) for the Mesozoic, and the fifth (1024) for the Paleozoic. Then the years of the geologic chronology will stand as follows:

Period or Age.	*Mean Estimate.*	*"F. of S."*	*Minimum Estimate.*	*Maximum Estimate.*
Post-glacial period..	7,100	4	1,775	28,400
Post-Columbia.....	200,000	16	12,500	3,200,000
Post-Lafayette.....	10,000,000	64	156,250	640,000,000
Cenozoic age.....	90,000,000	64	1,406,250	5,760,000,000
Mesozoic	300,000,000	256	1,171,875	76,800,000,000
Paleozoic.....	7,000,000,000	1024	6,835,937	7,168,000,000,000
Age of the earth[1]...	15,000,000,000	....	20,000,000	15,000,000,000,000

Such are the periods with which the geologist is accustomed to deal and the units by which he must reckon time; and the later, at least, are minimized even beyond the limit of conservatism.

V.—*The Time Measures of Anthropology.*

Apart from written history, anthropology is without a proper chronology. As among the older forms of life, so among men, generations are born, grow up and die, and stocks are developed and pass away in a series of rhythmic waves or cycles in which no

[1] Eminent physicists, including Thomson (Lord Kelvin), Newcomb and others, have estimated the maximum age of the earth, sun or solar system on the assumption that they are simple cooling bodies at about 100,000,000 years; but since the temperature of the earth (and so the rate of cooling) is materially affected by a complex terrestrial mechanism, and since, in general, the molecular degradation of cosmic bodies is accompanied by an atomic differentiation which must react upon the rate of cooling, such estimates cannot be accepted as final. Eminent geologists have estimated the minimum age of the earth by multiplying the observed rate of sedimentation into the estimated thickness of sedimentary rocks; commonly the rate of sedimentation is assumed equal to the rate of degradation as computed by Humphreys and Abbot, or 1 foot in 6,000 years, or a mile in 31,680,000 years, at which rate nearly 1,600,000,000 years would be required for the deposition of the 50 miles of sedimentary strata among the rocks of the earth; but so many unmeasured or variable factors enter into this estimate that it, also, may not be accepted as final.

point ever returns unto itself and which are not commensurable among each other, nor with the rhythm of geologic process, nor with the cycles of cosmic progression; but the cosmic revolutions on the one hand and the geologic periods on the other yield a chronology to which the development of Man may be adjusted approximately, albeit semi-arbitrarily.

The Age of Man is at once the last of the biotic ages and the beginning of a new era in which the selfish cunning of the beast gave birth to altruistic intelligence, and in which all other living things ceased to live unto themselves and became subservient to the higher power of cultured brain. The hours of the day of land animals were marked by the rise, culmination, and decline of inorganic types each better than the last; but the hours of the day of intellect are marked by inventions and institutions each giving character to countries or the entire world during the period of its dominance. In this way the Human Era has come to be made up of culture stages, sometimes overlapping, sometimes consecutive, and each better than the last—and the later among these stages are the subjects-matter of history. But the way from the bestialities of the prehistoric past to the humanities of history was long and devious, and is inscribed only in the obscure characters of the book of Archeology to which anthropologists and geologists hold keys different, but both required for the unlocking; so that while the later hours of human progress are clearly written, the morning hours and the dawn of the era are enveloped in the mist of remoteness. Accordingly, the earlier records of intellectual development must be deciphered from human relics entombed in the rocks and imbedded in caverns and river-silts before the chronology of Man can be developed, and not until the beginning of the Human Era has been fixed by some definite scale will the chronology be perfect. Thus the goal of anthropic chronology is the discovery of the beginnings of mankind.

In the present dearth of knowledge concerning the earlier stages in human development the antiquity of man may only roughly be estimated by successive approximations made alternately from the standpoints of historian and geologist. Now while an estimate conservative from one standpoint is radical from another, the truth commonly lies well between the extremes; and so a first approximation to an estimate of human antiquity from the points of view of history and geology may be essayed: More than two millenniums past the Chinese and the Hindus were astronomers, and the sages of

the Flowery Kingdom had established an astronomic period of 4,617 years; five millenniums past the builders of the pyramids had established a siderosolar cycle of 1,461 years; and in the absence of correct theory the recognition of at least the latter of these cycles implies empiric observation extending over a vast period. Moreover it is to be remembered that intellectual progress has proceeded with ever-increasing rapidity, that a day of the nineteenth century is even as a thousand years of primitive progress, so that the pre-astronomic portion of human existence must have been enormous. Accordingly it would seem that the records of early chronology carry the origin of man 10,000, or 20,000, or perchance even 30,000 years or more into the past. This estimate may indeed seem excessive when viewed from the standpoint of the written history originating in western Asia and preserved in southeastern Europe, yet it is in harmony with the hieroglyphs of Egypt and the traditions of the Orient. But if the measure of 7,100 years for post-glacial time be accepted, the estimate is radical when viewed from the standpoint of the geologist accustomed to date the origin of man at or long after the last ice invasion of the Pleistocene, for it implies the existence of a semi-civilization, at least, in the Orient and even in Africa while yet Arctic ice overspread northern Europe and America. So startling and distasteful is this conception that most geologists are disposed to carry back the date of this glacial invasion to 20,000, 50,000, or more years in the past. Yet this involves an equally grave difficulty; for even with the lowest estimate of post-glacial time—the unit of the geologic chronology—and with the most conservative estimates of the relative lengths of the greater periods beyond, the geologist is fain to demand many times more centuries for the building of the bedded rocks than the physicist is willing to grant for the cooling of the earth from the molten condition—the leading physicists of the world say that the planet cannot be more than 1,000,000 centuries old, while the foregoing estimate of the geologic periods gives 150,000,000 centuries since the earth divided itself into air, water and land. It is thus that the claims of History, Geology and Physics have to be adjusted and discounted in the common clearing-house of Anthropology.

Howsoever the conflicting claims of rival sciences are weighed, comparison of the several chronologic units yielded by astronomy, history and geology cannot fail to reduce estimates of the geologic antiquity of man. From the standpoint of history it is fairly conservative and from that of geology it is radical to carry man's origin

so far into the past as 20,000 years; but assigning the date of his advent to the beginning of the Pleistocene (*i. e.*, to the end of the Pliocene or the Cenozoic, or to the Columbia period) multiplies that period by 20, and assigning his coming to the Miocene multiplies it by 2,000. From any standpoint this extension of the human period is beyond serious consideration; to prove the Eocene, the Miocene, or even the Pliocene age of man would require more direct, unmistakable and indisputable evidence than would be needed to demonstrate that the pyramid of Cheops was built by steam hoisting machinery and the Chinese wall by the electric light. Moreover, viewed from the common standpoint of stratigraphic geology and paleontology, the improbability of human existence in the early Tertiary waxes well toward impossibility; for, as Boyd-Dawkins has repeatedly pointed out, *Homo sapiens* represents the culmination of a long line of evolution toward which the mammalian forms of the Pliocence had scarcely begun to point, yet all of these simpler and stabler organic types have faded with the flight of the Cenozoic eons. So while the antiquity of man may perhaps safely be carried 20,000 years into the past and that of the unknown anthropoid progenitor perchance as much farther, it is inherently improbable that real man existed beyond the middle of the Pleistocene, and inherently incredible[1] that he was born before the Pleistocene began.

[1] Inherent, or *prima facie*, or *a priori* incredibility is not to be confounded with impossibility. When a traveler through a previously unexplored country reports that the savage natives sometimes fell trees across streams for bridges, the report is inherently probable and is quoted without question, because that is the way of primitive peoples; if he states that the streams are spanned by stone arches, the statement is commonly regarded as inherently improbable and is not quoted without question, because savages are not known to understand the principle of the arch; if he announced the construction by savages of a stone arch of 250 feet span, the announcement would be inherently incredible, because it would imply engineering skill equal to that of the enlightened builders of the Trezzo Bridge of the Lombards and our own Cabin John Bridge, the longest arches in the world; while if he recorded the existence of a stone arched bridge of 2,500 feet span, his record would be rejected on the ground of impossibility, because stones are not strong enough to sustain an arch of that length. Yet he could surmount the inherent improbability in the second case by limited corroborative testimony, and the inherent incredibility of the third case by suitably designed photographs and other collateral representations in connection with that complete consistency of narrative which is commonly accepted as inherent evidence of veracity.

In the morning of the last day in the development of life on the earth cunning was born and prevailed; but the way from the cunning of the fox to the craft of the anthropoid was long, and it was well toward the present high noon of the day of intellect before bestial craft blossomed into the primitive genius that invented or enslaved fire and kindled the flame of humanity; and the rising hours of the forenoon may be estimated but not yet measured.

NOTE.—The several time divisions described are represented graphically in space units in the accompanying plate. Fig. 1 represents the natural time-units, Fig. 2 the historical eras, and Fig. 3 the geologic periods; but by reason of the wide range in values it has been found necessary to use six different scales in the diagrams. The first diagram is drawn to the scale used in the text for expressing time-units in terms of space units, *i. e.*, a thirtieth of an inch for a day and a foot for a year; and this is designated scale *A*. The successive scales indicated by the letters *B*, *C*, *D*, *E* and *F* are each one-hundredth of the next preceding scale. In scale *C*, which is used three times, a century is about an eighth of an inch, and a hundred centuries, or ten thousand years, is a foot.

RAISING AND FALLING OF THE SKY IN IROQUOIS LEGENDS.—In many of the Iroquois myths of the journeys of men and disembodied spirits to the Land of Souls, it is asserted that the sky raises and falls at the point of egress from this world, and that spirits which have not fulfilled their duties in this life are crushed by the impact of the sky at this passage. The origin of this notion seems to be in the fact that the fitful coruscations of the aurora borealis or northern lights dance over the nebulæ of the night, a phenomenon that they may have supposed was caused by the raising and falling of the sky, not suspecting that their explanation of the cause of the dancing of the aurora was a subjective notion. Confirmative of this explanation of the belief in question is the fact that usually this passage is located in the extreme northwest.

J. N. B. HEWITT.

TABU OF THE COW BY THE SHÎNS.—The noble caste of Shîns of Dardistan, who were expelled by the Brahmins from India or Kashmîr, held the cow in abhorrence as one of their religious dogmas, whereas in other ways they are really Brahmins, among whom Hindooism is found peeping out through the thin crust of Mohammedanism.—(LEITNER in Trans. Victoria Inst., xxiii, No. 90, p. 120.)

A STUDY IN BUTTS AND TIPS.

BY WASHINGTON MATTHEWS.

The ceremonial observances of the Indian priest are tediously numerous and minute. To the superficial observer they may seem equally arbitrary and meaningless, but a closer acquaintance with them shows that they are all based on definite theories, doctrines, or conceptions, and are consistent to a marvelous degree.

To declare with confidence what the underlying idea of any series of symbols may be is often impossible. The study of the symbols in any one race of people, in any one order of priesthood or in any one ceremony may be fruitless; but let us record painstakingly what we observe, and in the course of time the comparative study of our observations may bring a solution. I shall venture at present no conjecture as to the ultimate meaning of certain observances I am about to describe, but shall place them on record as suggestive to other observers who may have an opportunity to seek for something similar in the rites of other tribes.

These observances exist among the Navajo shamans and are to be seen in all of their many rites which I have witnessed. They arise from a marked distinction made between the butt and the tip—the cardiac and the distal, the basal and the terminal, the central and the peripheral—ends of all things. Through all Navajo symbolism the butt and the tip are carefully distinguished from each other, and the former always has a precedence over the latter.

The majority of the sacrifices offered to the gods are made by filling sections of reed (*Phragmites communis*) with native tobacco. In cutting up the reed used for a series of cigarettes they cut off a piece first from the end nearest the root, and they continue to cut off as many pieces as may be necessary from butt to point. The pieces, according as they are cut, are notched near the butt (with a stone knife), so that the relations of the two extremities of the piece may not be forgotten. All through the painting of the cigarettes and the various manipulations that follow, the butt end must be the nearer to the operator, and the tip end the further away from him. Since the cigarette maker sits in the west of the medicine-lodge facing the

east the cigarettes while there must lie east and west, with the tips to the east.

If a number of cigarettes are made for one act of sacrifice the first piece cut off is marked with one notch near the base, the second piece with two notches, the third piece with three notches, the fourth piece with four notches, all near the butt ends. This is done in order that they may always be distinguished from one another and their order of precedence from butt to tip may not be disregarded. When they are taken up to be painted, to have the sacred feathers of the blue bird and yellow bird inserted into them, to be filled with tobacco, to be sealed with moistened pollen, or to be symbolically lighted with the rock-crystal, the piece that came from nearest the butt (the senior cigarette, let us call it) is taken first, that nearest the tip last. When they are collected to be placed in the patient's hands, when they are applied to his or her person, and, finally, when they are taken out and sacrificed, this order of precedence is always observed.

The order of precedence in position when sacrifices are laid out in a straight row is from north to south; the senior sacrifice is in the northern extremity of the row, the junior or inferior in the southern extremity. When they are laid out in a circle the order is from east back to east by way of the south, west, and north.

The gods to whom the sacrifices are made have commonly also an order of precedence, and when such is the case the senior sacrifice is dedicated to the higher god, the junior sacrifice to the lower god.

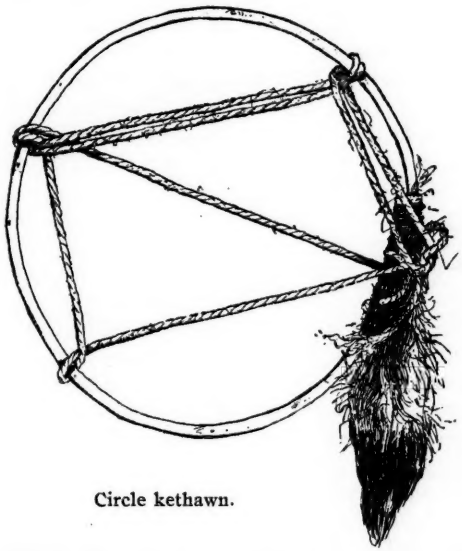
When it is required that other articles, such as feathers, beads, powdered vegetable and mineral substances, be sacrificed with the cigarettes, all these things are placed in corn-husks. To do this the husks are laid down on a clean cloth with their tips to the east, the cigarettes are laid in them one by one, each in a separate husk, with their tip ends to the east, and the sacred feathers are added to the bundle with their tips also to the east.

The most sacred substance of the Navajo priest is pollen. The pollen of various plants is used, but that of the corn is the kind most frequently employed. When dry pollen is sprinkled on the cigarette it is sprinkled from butt to tip. When moist pollen is daubed on the side of the cigarette it is daubed from butt to tip.

When a willow or other shrub is cut for some specially sacred object, as, for instance, to make the plumed wands with which the

shamans surround their dry paintings, pollen is rubbed on the stump and then scattered by the ascending hand in the air, in the place where the tree grew, from butt to tip, as if in sacrifice to the spirit of the tree; this with a prayer that the shrub may grow again. The top of the shrub, if trimmed off, is set upright as near to the stump as possible.

If the sacrifice is to be applied to the person of an invalid in order to effect a cure, it is first pressed to the soles of the feet and then to other parts of the body, going upward and ending with the crown of the head or with the mouth, which they properly regard as the extreme tip of the human being. If pollen is to be scattered on or applied to the person, a similar ascending order is observed.



Circle kethawn.

In some ceremonies pollen is sprinkled on the sacred masks while they lie face upward on the ground; in others it is sprinkled on dry paintings which represent these masks. It is applied in three places—the cheeks and the nose. It is sprinkled upward on each cheek, but downward on the nose, *i. e.*, from its butt to its tip.

In their sacred paintings, wherever the figures of men or plants are arranged radiating from the center, the feet or roots are always

directed toward the center of the picture and the heads or tips toward the periphery.

Other sacrifices—kethawns, or messages to the gods, as they are sometimes called—are made of various kinds of vegetable substances and in a great variety of shapes and colors. In making and handling these, also, the distinction between butt and tip is carefully regarded.

The accompanying figure represents, about half size, one of these sacrifices (which may be called a circle kethawn) belonging to the first night of the great ceremony of Kledji-Qaçal. The circle kethawns are twelve in number. Each is made of a carefully selected twig of aromatic sumac, two spans long. The diameter of the circle must be equal to that of a circle made by the constructor by bringing together the tips of his two bent forefingers and the tips of his two bent thumbs. It is usually about five inches, depending, of course, on the size of the constructor's hand. Great care must be taken in peeling the twig so as not to cut the surface of the wood beneath the bark, and great care must be taken, too, in bending it, for a fracture or abrupt bend ruins the twig for its sacred purposes. Held before the operator, it is bent sunwise. In bringing the ends together to complete the circle, the butt end goes the nearer to the center; the tip overlaps the butt and is placed on the circumference. The ends are tied together by means of a yucca fiber (fiber of leaf of *Yucca baccata*) exactly two spans long. To make the tie, the butt of the fiber is applied to the butt end of the twig, at first parallel to the latter and then encircling it so as to secure the parallel part in its place. The fiber is next wound around the spliced extremities of the twig until it is nearly all used; it is then secured by passing the tip end under the last turn and drawing it tight, in such a manner that its free extremity shall lie parallel with and on top of the extremity of the twig. Should now either the twig or the fiber extend beyond the other, the redundant part is cut off so as to make both exactly the same length, and this must be carefully done, so as not to injure the underlying surface of the twig.

When the circles are all completed a string is firmly tied to each and then secured in four places to the circle, so as to form on it an approximate square, with a loose crochet-knot, which comes easily apart when the free extremity is pulled. Each woolen string is a little over a natural yard in length, *i. e.*, it measures from the center

of the left breast to the end of the right thumb, the arm being fully extended. At the free end of each string is a white, downy eagle feather, which is so tied on that its butt is approximate to what may be considered the butt end of the string—the end further from the plume—and its tip approximates the tip end of the string. The butt of the string is tied on the circle at the splice, is then carried sunwise as it is applied to the kethawn, and loosely secured by a crochet half-knot near the site of the first tie.

These kethawns are piled up, one on top of another, as they are prepared, and are placed in a sacred basket. Although they undergo several manipulations, all are so arranged that when the kethawns come to be applied to the sick or bewitched man whom they are intended to heal, that which was made first comes on top of the pile and the others come in the order in which they were made, the circle made last being at the bottom. They are applied to the patient by three different gods, *i. e.*, men wearing the masks of gods, each one of whom enters the lodge singly, takes a single kethawn, applies, and carries it out. Each god therefore enters four times in order that the twelve kethawns may be disposed of. A fourth god belongs to the group, but he performs a different office. The last act of each application is to put the kethawn to the patient's lips, seize the plumed end, and unravel the string with a single pull. The god, still holding on to the string by its plumed end (the other being tied to the wooden ring), drags the kethawn out behind him along the floor of the lodge. Other very interesting ceremonies performed at this time will not be described here, as they throw no additional light on the subject of butts and tips.

As each sacrifice is taken out of doors, the string is wound loosely around the ring and the object is laid on the roof of the entrance to the lodge, where it remains the rest of the night. At dawn next morning all the kethawns are taken back into the lodge. Here the shaman takes off the strings and puts them back in his medicine bag. He unties the fastenings of the kethawns. He straightens out the yucca fibers and lays them together, parallel to one another, butt to butt and tip to tip. He does the same with the sumac twigs, and then makes one bundle of all the objects, laying them all tip to tip. While he does this the tips are held further from him than the butts and toward the east. This work finished, he hands the bunch of twenty-four articles to an assistant, who takes also a little corn meal in the hollow of his left hand and a small bag of pollen in his

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right hand. The assistant goes forth holding the tips of the twigs in advance. He runs a short distance in a northerly direction from the lodge. He lays his bunch of sacrifices horizontally in some secure place above the ground, such as the narrow fork of a tree. Murmuring a short prayer, he sprinkles meal on the objects from butt to tip with the left hand and sprinkles pollen on them in the same direction with the right hand. Then, leaving the sacrifice to the mercy of the elements, he turns around to the right and runs back to the lodge.

As indicated above, the strings are not sacrificed. They are properties of the shaman, contemporaneous with his professional career, and are used in various rites where loosening of some evil spell is to be symbolized. When the shaman unties them from the rings he bundles them up in a certain prescribed and invariable manner, always putting the eagle plumes together, *i. e.*, laying the strings tip to tip and pointing them all in the same direction. The strings are made for the shaman on the occasion of conducting his first ceremony after his ordination (if we can call the rite of admission into a pagan priesthood ordination), and he retains them ever after. If his first patient be a woman, it is she who spins the yarn for the strings. If his first patient be a man, it is his wife or other near female relative who does the spinning.

To record all the cases in which I have witnessed this ceremonial distinction between the butt and the tip would be to write a volume. I hope the instances given above will sufficiently serve to illustrate the principle.

KHÉ SUPERSTITION REGARDING THE COLOBUS MONKEY.—In speaking of the African people of Khé (lat. 3° 29′ S., long. 37° 26′ E.) Mrs. French-Sheldon says: "They have a curious superstition in connection with the Colobus monkey which I found among no other tribes. They believe that their ancestors inhabit the bodies of these creatures, and under no circumstances whatever will they kill or knowingly permit to be killed one of these beautiful apes, and on approaching the forest where the monkeys abide in great numbers there is an odd silence and furtive glances, as the natives pick their steps with precaution and almost hesitation, that would seem to indicate an honest belief in their superstition."—*Jour. Anthrop. Inst., Great Britain and Ireland, xxi, No. 4.*

THE PANAMINT INDIANS OF CALIFORNIA.

BY FREDERICK VERNON COVILLE.

To a traveler passing by rail across our southwestern desert region it is a matter of great wonder how the Indians of that country contrive to subsist. Those who are not familiar with the desert can imagine an apparently unlimited plain, devoid of trees and grass, without streams or springs, but provided with a vegetation of cactus and scattered low shrubs of greasewood and creosote bush. Nor does a closer inspection affect one more pleasantly, for all the shrubbery is either woody and indigestible, or resinous and rank both in smell and taste. There appear to be no animals but lizards, an occasional rattlesnake, and sometimes an abundance of hungry-looking jack-rabbits. The very first neccessaries of life appear to be absolutely wanting, and this state of affairs exists not for one mile only, nor for ten miles, but for hundreds.

Viewed from this point the desert Indians' means of subsistence is a subject of unusual interest. As a matter of fact, in their domestic economy the selection of raw food-materials has reached a refinement of a kind quite opposite to that of civilized communities. The question in the case of the latter is, "What will furnish us the best food?" of the former, "What will furnish us any food?" The writer could not but notice in the Chinese markets in San Francisco, with their dried cabbage, abalone meat, and duck's feet, a similar result of generations of contrivance to make a scant food-supply suffice. So unusual is it among American Indians that a tribe cannot procure sufficient food with comparatively little work that Fremont says, "These [the Indians of the Mohave Desert region] belong to the people who are generally known under the name of *Diggers*, and to these I have more particularly had reference when occasionally speaking of a people whose sole occupation is to procure food sufficient to support existence."[1]

The Panamint Indians of Inyo county, California, belonging to the widespread Shoshonean family, are representatives of this class of beings, and as they are now nearly exterminated and their customs

[1] Fremont's Second Report, p. 267.

and language are little known, the writer desires to put on record the following observations, made among them while he was performing the duties of botanist of the Death Valley expedition in 1891. A few notes on the neighboring Paiutes are included, designated in each case as such.

About twenty-five individuals of the Panamint tribe were seen, all of whom were living in the Panamint mountains, on the west side of Death valley. The total number probably does not greatly exceed this. The distance from Hot springs, in the vicinity of which three of the Panamint families live, to the nearest railroad station, Keeler, Inyo county, California, is about eighty miles.

In winter the Indians, leaving the mountains on account of the intense cold and deep snow, descend to the valleys and remain there until the extreme heat of summer compels them to return to higher altitudes.

At the mouth of Hall cañon, near Hot springs, at the west foot of the Panamint mountains, and in Johnson cañon, on the eastern or Death valley slope of the same range, the Indians have under crude irrigation and cultivation two or three acres of ground. The crops commonly raised are corn, potatoes, squashes, and watermelons. Of the last they are especially fond, fully as much so as the African, and the desert climate is admirably suited to their growth.

The cultivation of plants, however, furnishes them neither a sure nor an adequate food supply. They occasionally purchase from miners and prospectors bacon and flour. Their animal food consists principally of jack-rabbits, cotton-tail rabbits, and quails, occasionally mountain sheep or deer, and sometimes wood rats, kangaroo rats, white-footed mice, and a large lizard known as the chuckawara (*chuk'-ä-wâ-rā*).[1] They are seldom able, however, to obtain any of these in abundance, and they are compelled to rely mainly on various indigenous food-plants.

As in the case of most civilized communities, the greater portion of their plant food consists of starchy material in the form of seeds. Most important is the Nevada nut pine, *Pinus monophylla*, which grows abundantly in the mountains at an altitude of six to eight thousand feet. In early autumn, after the seeds have matured, but before the cone scales have opened, the cones are beaten from the trees,

[1] The diacritic marks used in this article are those employed in the Century Dictionary.

gathered in baskets, and spread out on a smooth piece of ground exposed to the heat of the sun. The scales soon become dry and crack apart, and the seeds are shaken out by blows from a stick or the more persistent ones rattled out by hand. The empty cones are then removed from the ground and the seeds gathered in baskets. Large quantities of pine nuts are thus collected, and most of them are cached in dry places among the rocks for use during the year. They are said to remain fresh and edible for several years if properly stored.

To prepare them for food the nuts are put into a basket with some live coals and shaken or stirred until they are gradually roasted. In this state pine nuts are often sold in market in California and other Western States, being disposed of precisely as peanuts are in the East. These roasted seeds, after the removal of their thin shells, may be munched entire or ground in a wooden mortar with a stone pestle and eaten dry or made into a soup.

The seeds of many other plants, indeed of almost all that are not poisonous, are also used. The methods of procuring them differ with the mode of growth of each plant, but the process of roasting is always the same. The pulverizing, however, in the case of harder seeds, is accomplished by grinding between two stones, the upper and smaller one being manipulated by hand on the lower, which is larger and slightly hollowed.

Oryzopsis membranacea, the common sand grass of the desert, produces an abundance of seed and is generally used. In gathering it the squaw carries in one hand a small basket and in the other a paddle made of wicker-work, resembling a tennis racket, but of only about two-thirds the size. With this she beats the grass panicles over the basket. After the process of grinding is completed, the chaff that remains attached to the grains is winnowed or sifted out.

Echinocactus polycephalus, a large round-headed cactus known as devil's pin-cushion, grows in rocky soil throughout the desert and fruits abundantly. The seeds are well protected among the spines and enclosed in white woolly capsules. These are pried out with sticks, broken open, and the seeds poured out. This cactus is especially serviceable to the Indians, as its seeds remain fresh and edible until spring, when most other sources of supply have failed.

The seeds of the joint pine, *Ephedra nevadensis*, are roasted and ground and the flour made into a bitter bread. *Œnothera brevipes* and other species of evening primrose are also commonly used.

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Berries and similar fleshy fruits are rare in the desert, and only one is known to be edible—that of *Lycium andersonii*. This shrub has a small red berry resembling a minute tomato and in its fresh state is quite palatable. It is often dried by the Indians and made into a mush or soup, apparently without cooking.

One of the prickly pears, *Opuntia basilaris*, is used by the Indians, prepared in a peculiar manner. In May and early June the flat fleshy joints of the season's growth as well as the buds, blossoms, and immature fruit are fully distended with sweet sap. They are broken off with sticks and collected in large baskets. Each joint, having been carefully rubbed with grass to remove the fine barbed prickles, is exposed to the heat of the sun. When they are thoroughly dry they will keep indefinitely, and are prepared for eating by boiling and adding salt. Instead of the drying process another more elaborate one is sometimes adopted. A hole, about ten inches in depth and three feet in diameter, is dug in the ground and lined with stones. Upon this a fire is built and other stones thrown in. When they are all thoroughly heated, the ashes, coals, and all but one layer of stones are scraped away, and some fresh or moistened grass spread in the hole. Next a layer of cactus joints is added, then more hot stones, and so on till the pile is well rounded. The whole is then covered with sacking (originally with a mat of sedges), and lastly with moist earth. After about twelve hours of steaming the pile is opened and the nä′-vō, as the cooked cactus is called, is salted and eaten. Prepared as it is, in larger quantities than can be disposed of at once, a portion is dried and preserved. It is then in texture and appearance similar to unpeeled dried peaches.

There grow in the desert several large crucifers, whose leaves and stems have about the taste of cabbage and are tender and probably easily digestible. Among these the most abundant are *Stanleya elata*, *S. pinnata*, and *Caulanthus crassicaulis*. The process of preparation for the first of these species, and undoubtedly for the others also, is as follows: The leaves and young stems are gathered and thrown into boiling water for a few minutes, then taken out, washed in cold water and squeezed. The operation of washing is repeated five or six times, and the leaves are finally dried, ready to be used as boiled cabbage. The operation of washing removes the bitter taste and certain substances that would be likely to produce nausea or diarrhœa. I was told by Mr. Frank Kennedy, a miner who had

lived many years among the Panamints, that when food is extremely scarce almost any green herbage is eaten, after a similar preparation.

The use of the mesquit bean, the fruit of *Prosopis juliflora*, is well known. The ripe pods, about four inches long, contain very hard bony seeds, but the spaces between them, morphologically the body and septa of the pod, are stored with a small amount of nutritious matter, consisting principally of sugar. Mesquit pods are exactly homologous in the position of their sugar deposit with the Johannisbrod or St. John's bread of the Mediterranean region. Mesquit pods are seldom used in the autumn, but at that time are gathered and cached until spring. The usual method of preparation is to pound the dry pods in a wooden mortar, sift out the flour, and make it into small cakes or loaves.

Phragmites vulgaris, the common reed, furnishes what is known as "sugar." In early summer, commonly in June, when the plants have attained nearly their full size, they are cut and dried in the sun. When perfectly brittle the whole plant is ground and the finer portion separated by sifting. This moist, sticky flour is moulded by the hands into a thick gum-like mass. It is then set near a fire and roasted until it swells and browns slightly, and in this taffy-like state it is eaten.

Although the Panamint Indians live in a region where no species of *Agave*, or mescal, grows, they use in a similar manner a certain part of the tree yucca, *Yucca brevifolia*. In April when the flower-buds are swelling, but still covered with young leaves, they are in the proper condition for food. The buds are terminal upon the branches, and are protected by a close rosette of serrated, stiff, pointed, almost dagger-like leaves. The fiber of these leaves is so tough and the situation of the buds on the stem such that it would be difficult to cut one out even with an axe or hatchet. The Indians substitute dexterity for instruments. The four or five uppermost mature leaves are drawn together over the apex of the bud and grasped by the hand; then, by a twist and a quick, sidewise bend, the head is broken off. This is rendered possible by the skill of the worker and by the fact that the stem, although in age exceedingly tough, in its young stage is quite brittle. The mature leaves and the green tips are discarded, leaving an egg-shaped, solid, cream-like, juicy mass. This is roasted on hot coals and eaten at once or kept until cold. The tissues of these young buds are full of sugar

and other formative carbohydrates, and are undoubtedly very sweet and nutritious.

In some parts of the Charleston mountains, Nevada, the Piutes use a small mescal plant, *Agave utahensis*, which grows there in great abundance. Near the summit of Mountain Spring pass, north of Olcott peak, some of the hillsides are almost covered with the plant, and in suitable places near by are the holes where in previous years mescal has been cooked. These mescal pits, as they are called, are in their present condition circular depressions in the ground six to twenty feet in circumference, and sloping evenly to a center one to three feet in depth. They are deeply lined with water-worn stones, best described as coarse gravel, too small to be called cobble-stones. In the center of some of the pits were a few larger similarly worn stones and an occasional piece of charcoal. One of the Indians, an old man living near Vegas ranch, described to me imperfectly the method of cooking it. A great fire is built in a pit and kept up until the stones are very hot. The fire is then raked out, the mescal plants put in, and covered with grass. After two days' steaming the pile is opened, and the mescal is ready to be eaten. The edible portion is the short, thick axis and the bases of the young leaves. Mrs. Stewart, at Vegas ranch, described the cooked mescal as having a jelly-like appearance and texture and a delicious taste. Extending through the pulp of the young leaves are tough fibers that are not softened by the cooking. These are ejected from the mouth after the edible portion has been chewed out. At some forsaken Indian camping grounds on the banks of the Colorado river, close by the mouth of the Vegas wash, we found dried and weathered wads of this fiber of such size as to indicate that the mescal must have been eaten in tremendous mouthfuls. It should be stated here that this species of *Agave* closely resembles the common century plant, but its leaves are more numerous and more closely compacted, while their length rarely exceeds eight inches. When the plant is a few years old it sends up a flower-stem sometimes ten feet high, bears fruit, and dies. The spring buds of plants about to flower contain the accumulated reserve material necessary for this extraordinary growth, and are therefore evidently full of food-material. I was informed that the cooking of mescal took place late in April, and that it is accompanied by certain ceremonies.

The Panamints have retained the majority of their original culinary utensils, although a few others have been adopted from white

people. The knife, spoon, tin plate, iron kettle, and flour sieve are frequently used. Nowhere were clay or stone pots seen, but various receptacles made of wicker-work, such as pack-baskets, plates, pot-baskets, and water-baskets, were in every-day use.

The pack-baskets have the form of a funnel, from one and one-half to two and one-half feet high and not quite so broad. A median vertical section is V-shaped, with a blunt base. This is the ordinary receptacle for carrying, or "packing," as it is called in mining regions, any kind of material. The loaded basket is held against the back between the shoulders, either by the hands grasping its rim or by leather or rope thongs passed around the forehead, the body meanwhile bent forward.

The plates are small, flat, circular pieces of closely woven wicker-work, usually nine to twelve inches in diameter. They are flexible and sometimes slightly saucer-shaped, and are used not only as plates and pans but also as substitutes for sieves. The material to be sifted, composed of ground seeds, is placed upon the plate and the chaff winnowed out. This primitive method is probably more difficult and less satisfactory than that used in our kitchens, for in the possession of nearly every Indian family a common wire flour sieve was seen.

The name pot-basket is used to designate wicker-work receptacles that have the form of a pot or bowl. The one in most common use has the shape of a rather deep bowl with curved sides and a flat bottom, and has a capacity of about three pints. The squaw uses it as a general measure, as a bowl for dry food and for soup, and often, when in the sunshine, as a hat. Its texture is so close that, when well made, it holds water. It is probable that before the advent of the iron kettle the Panamints used these wicker-work pots for the purpose of boiling and stewing food, applying the heat by the ordinary process of dropping hot stones into the liquid. Most of their starchy food, however, is roasted dry by mixing seeds, before they are ground, with hot coals and stirring them in a basket. This process is still largely used.

The water-basket has commonly a capacity of two to three gallons. Its general outline is that of an urn with a narrow neck and a rounded, conical bottom. The entire inner surface and frequently the outside is coated with pitch. Woven into the shoulder of the basket on one side are two loops of horsehair or other strong material, to which is attached a thong. In carrying, this thong is

passed around the forehead, while the basket is rested on the back between the shoulders.

Besides these articles of domestic use others of modified form are employed suited to individual taste and needs. Among the mixed Paiutes and Shoshonis at Ash Meadows, Nevada, was seen a very broad, shallow, flat-bottomed kind of bowl about one to one and a half feet across and about four inches deep. Loosely woven bird-cages are also used by the Panamints.

All these wicker-work utensils are woven by the squaws at the cost of a great deal of time, care, and skill. The materials are very simple. They consist of the year-old shoots of some species of tough willow, commonly *Salix lasiandra*, the year-old shoots of the aromatic sumac, *Rhus trilobata*, the long, black, slender, flexible horns on the mature pods of the unicorn plant, *Martynia proboscidea*, locally known as devil horns, and the long, red roots of the tree yucca, *Yucca brevifolia*. These materials give three types of color, the white of the willow and sumac, the black of the devil horns, and the red of the yucca roots. This last material, although it has a strong fiber and a pretty red color, is rarely used, for it is too thick to plat closely and the resulting fabric is full of interstices.

Sumac and willow are prepared for use in the same way. The bark is removed from the fresh shoots by biting it loose at the end and tearing it off. The woody portion is scraped to remove bud protuberances and other inequalities of the surface, and is then allowed to dry. These slender pieces of wood, that they may be distinguished from the other elements of basket materials, will be called withes. The second element is prepared from the same plants. A squaw selects a fresh shoot, breaks off the too slender upper portion, and bites one end so that it starts to split into three nearly equal parts. Holding one of these parts in her teeth and one in either hand, she pulls them apart, guiding the split with her fingers so dexterously that the whole shoot is divided into three equal even portions. Taking one of these, by a similar process she splits off the pith and the adjacent less flexible tissue from the inner face, and the bark from the outer, leaving a pliant, strong, flat strip of young willow or sumac wood. This is here designated a strand. Both withes and strands may be dried and kept for months and probably even for several years, but before being used they are always soaked in water.

The pack-baskets and some, at least, of the water-baskets are made

of these strands and withes. They begin at the bottom with two layers of withes superimposed and fastened by their middles at right angles. The free ends are bent upward, and in and out between them the strands are woven, new withes being inserted as the basket widens. An attempt at ornamentation is frequently made by retaining the bark on some of the strands or by staining them, and by slightly varying the "weave." A squaw commonly occupies an entire month constructing one such basket.

The plan of the pot-baskets and plates is very different from that of the pack-baskets. The materials are all carefully selected and prepared. They consist of willow or sumac strands like those described above, but narrower and of the finest quality, similar black strands from the devil horns, and the long-jointed, slender stems of a native grass, *Epicampes rigens*. The strands of devil horns are exceedingly tough, of a coal-black, very persistent color, and attain a length of from four to ten inches. The grass is particularly adapted to this use from its firm texture and the fact that the portion above the uppermost joint, which alone is used, is very long, often eighteen inches.

Starting from a central point a bundle of two or three grass stems and one very slender withe is sewed by a willow strand to the part already finished. The process is very similar to the crocheting of a circular lamp mat. At the proper point the bundle is drawn more tightly, so that the remainder of the spiral forms the sides of the basket. The wall has the thickness therefore of one of these bundles, and is composed of a continuous spiral of them. The willow withe furnishes a strong hold for the stitches, and the punctures are made by an iron awl. When such an instrument cannot be obtained an admirable equivalent is substituted in the form of a stout, horny cactus spine from the devil's pin-cushion, *Echinocactus polycephalus*, set in a head of hard pitch. The grass stems, when the stitches are drawn tightly, make a perfect packing, and the basket when finished is water-tight. Curious patterns in black are woven into the basket by the occasional substitution of strands of devil horns for those of willow.

Although the majority of the Panamint men use a short gun or a rifle in hunting, they still retain, as an accessory instrument for shooting small game, the bow and arrow. They shoot with remarkable accuracy and force, and since time is of little value to them, they are able to lie in wait for their game and creep so closely to it

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that this method of hunting is very effective. I have seen an arrow-shaft that bore dried blood and rabbit hair five inches backward from the point.

The bows are made from the desert juniper, *Juniperus californica utahensis*. The Indian prefers a piece of wood from the trunk or a large limb of a tree that has died and seasoned while standing. One must remember that at low altitudes in these desert mountains moist rot of dead wood never occurs, but that a mature tree subjected to the intensely dry heat of the region is in perfect condition for this use. The bow rarely exceeds three feet in length, and is strengthened by glueing to its back a covering composed of strips of deer sinew laid lengthwise along it. The string is made of twisted sinew, or sometimes of cord prepared and twisted from Indian hemp.

Arrows are made from the stems of the reed, *Phragmites vulgaris*, and from willow shoots. The shaft is about three and one-half feet long. Nearly mature but still green reeds are cut, their leaves removed, and the stems dried and straightened in the hands before a fire. In the straightening process use is often made of a small stone across the face of which have been cut two grooves large enough to admit an arrow-shaft. This stone is heated and a portion of the crude arrow is laid in one of the grooves until it is hot. The cane is then straightened by holding it crosswise in the teeth and drawing the ends downward. By repeating this process throughout the whole length of the shaft a marvelously straight arrow is produced.

The head of the arrow is a pin of very hard wood, taken, I believe, from some species of *Atriplex* or greasewood. It is about five inches long and tapers evenly to a blunt point. The base is inserted about three-fourths of an inch into the hollow of the reed and rests against the uppermost joint. It is bound in place by a thin band of sinew. At each joint of the arrow-shaft is burned a ring of diagonal lines, either for ornament or as a tribal mark. The base of the shaft is notched to receive the bow-string and feathered with three half-feathers bound on with sinew and slightly twisted to give the arrow a rotary motion.

Willow arrow-shafts are made in a similar manner, one of the processes, corresponding to what we know as sand-papering, being accomplished by drawing the stick back and forth in the angle between two flat stones held in the palm of the hand. Stone arrow-heads appear to have fallen into entire disuse among the Panamints since the days when they were employed in war.

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No textile fabrics are manufactured by the tribe, for they buy from the whites sufficient cloth for their wants. They do, however, manufacture from the Indian hemp, *Apocynum cannabinum*, a strong, fine-grained white cord, which is used instead of sinew whenever there is danger of moisture. Horsehair is undoubtedly sometimes made into rope by these Indians. At Vegas ranch, east of the Charleston mountains, Nevada, a Paiute was seen making a lariat of this material.

Of the facial paints that are used, principally by the women, little could be learned, but some of them are made of colored stone ground to a powder; and one kind, of a brilliant vermilion hue, is known, curiously enough, to have been purchased from the Chinamen at Keeler. It was a genuine imported article.

For cements are used a glue made by boiling the horns of the mountain sheep, pitch gathered from the Nevada nut pine, *Pinus monophylla*, and a gum found upon the creosote bush, *Larrea mexicana*. This last product is an interesting one. In its crude form the larrea gum occurs in the form of small, reddish, amber-colored masses on the twigs of the shrub, and is deposited there by a minute scale insect, *Carteria larreæ*. The crude gum is mixed with pulverized rock and thoroughly pounded. The product, heated before applying, was once used to fasten stone arrow-heads in their shafts, and is at the present time employed for other similar purposes. At Ash Meadows, Nevada, I was shown a broken sugar-bowl cover that had been neatly and firmly mended with this cement by an Indian.

THE FISH IN LOCAL ONOMATOLOGY.—Names taken from fish and fish species are rather frequent in well-watered countries. The Algonkin term *náme* is the generic word for "fish," but in the Ojibwē language spoken around Lake Superior it has passed into "sturgeon," this being the fish most sought after on that rock-bound lake. *Námek*, a derivative of *náme* and abbreviated into *ámek*, retains the definition "fish" in the combination of *atikámek*, "whitefish," in Ojibwē; this is found also as a hydrographic name. On the Pacific coast we may expect the various names of salmon to be largely applied to rivers, for that fish was the staple food of the natives long before the advent of the whites. We have the Californian Cósumne river, named after *kóssumi*, the term for salmon in the Mutsun

dialects spoken west of the towering range of the Sierra Nevada. Choupique is found repeatedly in this French orthography throughout Louisiana as the name of rivers, bayous, and lakes in which the *tchúpik*, a small fish species, is living (Cha'hta). A similar signification belongs to the term *káyus*, in the Yakima dialect of the Shahaptian family, as spoken on middle Columbia river, and the Cayuse tribe appears to have originally dwelt on a brook or rivulet frequented by this fish. Tchúla pápa or Trout creek, in Florida, is a name worded in the Seminole-Creek language, the verbatim rendering of the term being *tchúla*, "trout;" *pápa*, "eating place," from *pápās*, "I feed upon." To the same language belongs and worded in the same manner is "Charley Apópka," in De Soto county, near Charlotte harbor, southwestern coast of Florida. This is a corruption of *Tsála pápka hátchi*, "catfish eating creek," *hátchi* being the generic term for "river," "creek," and "bayou" in Cha'hta, Creek, and Hitchiti. The catfish is also represented in the Wissahickon, a brawling tributary of the Schuylkill, near Philadelphia. Here for many years existed a number of restaurants with the ever-repeated shibboleth of "catfish and waffles." One of the Indian names of the man-eating Botocudo tribes, upon and near the eastern coast of Brazil, was Gaimurés or Aimorés, a Tupi term referring to a species of the thorny rock-fish family inhabiting the ocean on that coast. Its roe was known to be quite poisonous, and was therefore carefully avoided. Tallahatchie river, a tributary of the Yazoo in northern Mississippi, is named after the pearls found in it, and Pearl river, which empties into the Gulf of Mexico in the same State, once had the same Cha'hta Indian name. *Tála* in the latter dialect means "stone," "rock," and here it stands for the pearl found in the shell of the bivalve.

A. S. GATSCHET.

ORNAMENTS OF HUMAN TEETH AND BONES.—In parts of British New Guinea, particularly on the island of Kitava, widows wear the ornamented lower jaw of the deceased husband as a pendant, and widowers wear the seventh or first cervical vertebra of the deceased wife tied into the hair behind. Both sexes also wear on the neck the teeth of the deceased.—*MacGregor in Scottish Geog. Mag., Sept., 1892, p. 497.*

NOTES UPON SOME GEOMETRIC EARTHWORKS, WITH CONTOUR MAPS.

BY W. H. HOLMES.

The ancient works to which this paper refers have been described and in a measure illustrated in numerous publications, notably in the great work of Squier and Davis and in the reports of Dr. Cyrus Thomas. The reason for again bringing them to the attention of archeologists is found in the fact that a recent survey has been made in which new methods were employed and results of considerable interest are assumed to have been secured. It is important that the maps made should be published along with an adequate record of the work done. This resurvey was made as the result of a discussion initiated by Dr. Thomas in which certain features of configuration and mensuration were considered. The letter of Dr. Thomas may very properly be given in this place:

To the Director, Bureau of Ethnology.

SIR: I have reached the point in the final work of preparing my second volume for publication where I am compelled to express some opinion in regard to two or three of the geometrical works of Ohio. I have just returned from a visit to them, made for the purpose of studying the topography. Now, what I wish especially at present is to ask you to submit the following questions to some person who will endeavor to give me the best possible answers which the data will admit.

Suppose that previous to the year 1760 a surveyor, officer, or other person had been required to lay out a large circular work on level ground in Ohio, what degree of symmetry could be expected? What instruments and what unit of measure would have been used?

The question is not purely theoretic, but relates to two works found in Ohio and described in my bulletin on "The Circular, Square and Octagonal Earthworks of Ohio"—one known as "Observatory Circle," described on pp. 16-17, pl. 3; the other the circle of "The High Bank Works," described on pp. 21-22, pl. 6. The object in view is to ascertain, first, whether the dimensions of these works coincide with the unit of measure used at that time; second, whether the degree of accuracy likely to have been attained was greater than that which might have been attained by Indians by the use of rope or cord in striking a circle.

That we must go some time back of the year 1760 we know historically, as these works were visited that year and found to be covered in some places by trees.

I do not expect any other result from this inquiry than to cast strong doubt upon the theory of European or civilized assistance in the construction of these works, but I wish to obtain the opinion of some one devoting attention to the mathematical sciences.

It is remarkably strange, however, that a circumference of 50 chains (4-pole) will give so nearly the exact diameter of these two works.

Very respectfully, CYRUS THOMAS.

This letter was referred to Messrs. Henry Gannett and Marcus Baker, the former Chief Geographer and the latter Chief Computer of the United States Geological Survey. The subject was considered by these gentlemen, and the Director authorized the resurvey of the Observatory circle at Newark, the Fair Ground circle at Newark, and a similar circle at Chillicothe. My attention having been called to the proposed survey, I prepared the following letter, which was intended to call attention to certain features of the survey of such remains that in my opinion deserved more careful attention than would probably be given them by the topographic engineer. This letter may be included in this report, and is as follows:

To the Director, United States Geological Survey.

SIR: I learn from Mr. Marcus Baker that it is proposed that he and Mr. Gannett visit a number of the so-called geometric earthworks in Ohio for the purpose of surveying and otherwise studying them, with a view of acquiring an exact knowledge of their configuration, etc. Being much interested in this matter, I take the liberty of calling your attention to a few points that may otherwise be overlooked, thus leaving the work in unsatisfactory shape.

In the first place, I would observe that so far as the determination of the present shape of a given monument or work is concerned, it is to be expected that skilled topographic engineers will be able to reach accurate results and to express these fully and clearly. It should be noted, however, that these ancient works are often obscure, and that the forms are in all cases rounded and indefinite. Before the application of the machinery of precision to the measurement of such forms the eye must be employed to assist in forming judgments as to the position of datum points, and this necessarily introduces a considerable element of uncertainty. In selecting the summit point of a mound or the median or crest line of a work, the judgments of two persons may vary a number of feet, and where indefinite marginal outlines are considered there is much greater chance of difference. The fixing of datum points for the measurement of a work of this class calls for mature consideration by a number of

observers of experience and skill. In this way fairly reliable results may be obtained, but it must be observed, in the second place, that these results relate to the present shape of the work only, whereas the real aim of the investigation is to secure an accurate knowledge of the original configuration. Conclusions based upon measurements that do not take into consideration all possibilities of form modification from the period of original construction to the present day must be unsatisfactory and may be seriously misleading. How, then, shall this matter of the modification of an ancient work be considered and by whom? Who shall say what change has taken place through prolonged use by the builders themselves or how much the encroachments of succeeding peoples have reduced or increased the original symmetry? Who is to determine the effect of rain and wind and to estimate the kind and amount of degradation by gravity in its various forms? Who can give an intelligent notion of the action of these and numerous other agents of deformation and of the results attributable to them? It is manifest that two classes of experts should consider the works conjointly, those having an intimate acquaintance with the action of the modifying agents and those well versed in the nature and history of the works examined.

In brief, what I wish to say is (1) that the mean of a number of judgments as to datum points for measurement is better than a single judgment; (2) that each datum point is useful in proportion to its approximation to the original point it is intended to represent, and (3) that the degree of that approximation will depend upon the competency of the experts employed. I beg respectfully to suggest that if this work is taken up the party of survey comprise, beside the engineers, at least one geologist having a ripe knowledge of the subtle but powerful monument-deforming agencies of nature, and one or more ethnologists equally well informed upon the nature and history of the structures to be measured.

Very respectfully yours, WM. H. HOLMES.

The party consisted of Messrs. Gannett, Baker, Aplin, and the writer, and took the field in October, 1891. It was found impossible to secure the aid of all the specialists recommended in my letter; but this proved not a serious matter, as Mr. Gannett desired not so much to attempt the answer of Dr. Thomas' questions as to try the experiment of employing contours in the mapping of the earthworks and at the same time to test the accuracy of the former surveys.

The work in the field was confined mainly to the preparation of contour maps of the three circles mentioned. It is not claimed that new elements of great importance have been added or that the work is greatly superior to that of previous surveys. The chief advantage of the present survey consists in the employment of the

contour system, by which means we are able to exhibit absolute relief, and to a certain extent the relations of that relief to the topography of the sites. By this method there is some loss of graphic clearness because of the inadequacy of expression of contours of relatively wide interval, but the expression of hachure maps on the scale heretofore used is notably inadequate in this and in many other directions. The defects of the earlier maps are more pronounced for the reason that the final drawings were made from field sketches subject to interpretation by the draughtsman. In the present case the drawing was done upon the spot. The three maps have been engraved and are presented herewith.

The visit was made in the fall of the year, when the conditions happened to be the best possible; crops had been harvested and the foliage had to a great extent fallen from the trees, the only impediment encountered being the scattered forest trees covering portions of the Newark works. The plane-table was used in the survey, and the hand level served to determine the profiles. For convenience of mapping it was deemed best to place stakes upon the crests of the works at intervals of about 100 feet. That these might represent the true or original crest as well as possible under the circumstances, Mr. Gannett and the writer did the work conjointly. The crests are as a rule quite flat and the median line is difficult to determine. On those portions of the walls reduced by the plow or modified by trails and roads the limit of possible error may in cases reach as much as six feet, but elsewhere this range is probably never more than two or three feet. That the errors actually made average very low is shown by the close correspondence between the results in this and in the former survey. Profiles were made at each stake with the hand level, extending from the outer to the inner margin of the structure, no matter how much spread out by the plow or by other agencies of degradation. Contours were drawn in upon the spot and the map thus made was ready for the engraver.

In transmitting these results to the Director, Mr. Gannett presented the following memorandum:

"The methods and instruments employed in surveying these three works were identical and can be described in a few words. The principal instrument used was the plane-table, and locations were made by triangulation. Within each circle a base-line was measured with a steel tape. Points upon the summit of the circle at an

average distance apart of about a hundred feet were selected and marked by stakes. Each of these stakes was then cut in upon the plane-table from each end of the base-line, and checks on the locations were obtained by occupying in a similar manner points thus located upon the summit of the circle.

"At the same time that these points were located their heights were measured with the vertical arc of the alidade, a telescopic alidade being, of course, employed. There was thus established around the summit of the circle the location and height of a series of points approximately one hundred feet apart. Then at each of these points a cross-section was made of the ridge, including, in the case of the Fair Ground circle, the ditch also. These cross-sections were made by the use of the steel tape for distances, and a hand level for differences of height. Special care was devoted to the entrance to the Fair Ground circle and the observatory of the Observatory circle, upon which many measurements were made in order to get their shape and dimensions correctly. Based upon these measurements, the works were sketched upon the plane-table sheet while upon the ground.

"The survey of the Observatory circle, which was the first survey, occupied four men for the greater part of two days, that of the Fair Ground a little more than a day, while the High Bank circle, which was the last surveyed, required the work of three men somewhat less than a day."

Although no attempt has been made to answer fully the questions asked by Dr. Thomas, it would appear that, on account of the decided variations from symmetry in the figures themselves and the impossibility of saying whether these variations have been increased or diminished by erosion, the discussion of the possible use of any known unit of measure is practically useless.

If the works had been laid out by the whites there appears to be no reason why the builders should have adhered rigidly to the true geometric form based upon the unit of measure employed, and certainly there is not the least doubt that if the aborigines desired a true circle they had the capacity to lay it out and to construct the work accordingly.

The Observatory Circle.

The circular embankment known as the Observatory circle has attracted a large share of attention, and is only inferior in interest

and importance to its rival in the same great group or system of works, the Fair Ground enclosure. The survey of Squier and Davis was made nearly fifty years ago, and before the primitive forest had been disturbed or the embankment seriously modified. Investigators can safely rely upon their statements and illustrations as to the appearance and condition of the work at that time, and the present examinations show that their map and illustrations, though wrong in some minor details, are in the main correct. In their map of the group of works this circle is represented as symmetric and uniformly well preserved. A slight discrepancy is seen between the representation of the Observatory mound on their map and that shown in their cut. The latter, according to present observations, is correct as to the relation of the parts. The error in their general map crept in, no doubt, during the processes of drawing and engraving. The cut given by Squier and Davis is reproduced in Fig. 1. The form

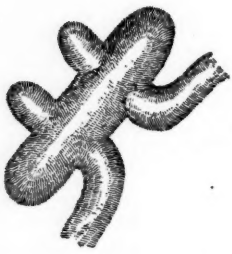

FIG. 1.—From Squier and Davis.

FIG. 2.—Present conformation.

The "observatory" feature of the circle.

as it appears to-day is given on nearly the same scale in the accompanying map, Pl. I. Comparison can be instituted to better advantage, however, with the hachured sketch given in Fig. 2, which is on a larger scale. The form is seen to be more rounded and indefinite than in the Squier and Davis cut, although it is slightly emphasized throughout. A careful study of the earthwork itself is necessary to the discovery of the precise relations of the cross-ridge to the out-curved ends of the inclosing wall. In the map published by Dr. Thomas[1] these relations are not brought out, and a slightly

[1] Cyrus Thomas. Circular, Square and Octagonal Earthworks. Bulletin, Bureau of Ethnology, 1889.

erroneous impression is given of the manner in which the out-curved walls of the circle connect with the cross-ridge or link.

The slight depression now seen in the middle part of the connecting wall may be the result of recent excavations, which have left numerous pits and have tended to destroy the symmetry of the work. It may be further stated that the map furnished by Dr. Thomas does not express literally the present condition of the encircling wall, but represents it as of uniform width and height throughout. The contour map will serve much better as a record of the present condition of the work, expressing, though still imperfectly, the reductions made by the plow and for roadways. As shown in the contour map, the wall northward of the observatory mound and continuing around to the gateway on the northeast, save at the first fence crossing, is much reduced in height and greatly spread out by the plow and harrow. From a point a little to the southeast of the gateway around the eastern side to the observatory hill, the original forest has never been fully removed, save at two points—one at the lane crossing, where the wall is reduced almost to the original level of the ground, and the other next the observatory, where for a space of about 100 feet it is reduced to less than half the original height by the plow. Between these two reduced spaces the embankment preserves apparently nearly its original height, but the plow has encroached upon the inner and outer margins, reducing the width and altering the profile.

So far as now can be determined, the embankment has never had other than a well-rounded profile, the crest being as acute as stability would allow and the sides descending at a high angle to the ground level.

The original conformation and use of the peculiar feature known as the observatory must remain forever a secret. The slight depressions inside and outside of the middle of the connecting segment are suggestive of a former passage through or beneath that portion of the work. A depression some five or six feet deep and perhaps 200 feet in diameter occurs just outside of the wall at this point, another may be seen in the angle between the wall of the circle and the south wall of the gateway leading into the octagon, and a third occurs on the outside just to the east of the lane at the crossing of the circle. These may be remnants of the pits from which the earth for construction was obtained. There are other slight irregularities in the surface within and without the inclosure, but it cannot be shown that they are in any case artificial.

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On the west side and not more than 200 feet from the wall of the circle, the plain upon which the works are situated falls off in a steep terrace some 25 feet high to a lower level but slightly higher than the flood plain of Raccoon creek.

Twenty-nine stakes were set. The most satisfactory circle obtainable had a diameter of 1,054 feet; only one stake of the 29 varied more than 3½ feet from this circle, and that stake was at the southeast opening of the gateway, where degradation has been confined entirely to one side of the wall. These figures were obtained before the measurements of Dr. Thomas were referred to, and the comparison is interesting as showing the very close approximation of the two surveys.

The Fair Ground Circle.

The Observatory circle is fast disappearing from view. The Fair Ground circle, in the same group, a mile farther east, has remained in nearly its primitive state. This is no doubt due greatly to the massiveness of the work, to its steep, high declivities forbidding intrusion, and to the presence of an inclosed ditch difficult to cross even afoot. It is still, as described by Squier and Davis fifty years ago, a most impressive work, its grand dimensions causing one to wonder if the North American Indian was ever equal to the task of its construction.

In beginning the work of survey a base-line was laid down across the level grounds of the inclosure, and stakes at intervals of about 100 feet were set as nearly as possible upon the crest line as determined by the adjacent slopes. Profiles were made through each of these stakes at right angles to the trend of the wall. As stated by Squier and Davis, by Dr. Thomas and others, the inclosure varies considerably from a true circle, the greatest variation of diameters being about 33 feet. There are numerous irregularities of the crest line as now determinable. The effect is as if the builders had worked by a large number of straight lines rather than by a regularly curved one. The floor within the inner brink of the trench is quite uniform in appearance, although it varies in level some four or five feet. Without the wall the surface of the ground is considerably varied, a very decided depression occurring southward from the gateway and adjacent to the marked sag in the wall. It is not improbable that this depression and that north of the work, and

containing water at the time of the Squier and Davis survey, were the source of a large part of the earth and gravel used in construction. These basins served also, no doubt, to furnish a supply of water to the occupants of the mound-building community. There are no vestiges of canals leading from the river to these reservoirs and no indication of a means by which water could have been conducted into the great trench within the inclosing wall. As shown by the contour map, the embankment is, and no doubt always was, higher and more massive at and near the gateway. It is difficult to say just how much of the variation from symmetry now so noticeable is due to original construction and how much to subsequent degradation. The deep depression in the profile at the south side was doubtless a feature of the original conformation. The material composing the work is for the most part a rather fine gravel which sustains forms in which it is embodied with great permanence. The plow of the white man has not invaded this great work, but roads and footpaths have produced many changes, and if the present use of the site as a fair ground is not discontinued, a few generations will witness its practical demolition. The crest and many of the more accessible slopes are already modified by roads and footpaths. The construction of a race-track has also served to destroy the inner margin of the trench around the western border.

The trilobate mound in the center of the inclosure is so low that it is not well expressed by the contours. The height of the central mass is nearly five feet above the general level; the lateral lobes are about three feet high. At present there are no traces of the four prominences or crests indicated upon the map of Squier and Davis, Fig. 12, p. 68, or of the two prominences on the lateral lobes shown by Dr. Thomas; neither is there any indication of a low, curved embankment just beyond the central lobe, as indicated by the former authors. It should be noted that the contour map does not assume to give all details of conformation and may be inaccurate in a small way in the expression of what is given. The only measurements made of height and width were sections at the stakes, and the contouring between these profiles was done by the eye. The contour interval is two feet. It may be said of the map given by Dr. Thomas that as to general shape and dimensions it is sufficiently accurate, but errors in detail have crept in, perhaps through misinterpretation by the draughtsman. A comparison with the contour map, Pl. II, will show that the width of the embankment and trench is not great

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enough and the width of the roadway at the entrance is too great as a result of this lack of width in the walls and trench. There is in Dr. Thomas' map no attempt at the expression of variations of height or width or of details of conformation.

The following are a few of the measurements made: 26 stakes were set upon the crest of the wall. Upon the plane-table sheet a center was found experimentally by projecting a circle, leaving nearly an equal number of stakes within and without, the mean distance from the line of those without equalling the mean distance of those within. The diameter of this circle was 1,185 feet. The outermost stake was 12 feet outside of this circle and the innermost stake 13 feet inside, making a total variation of 25 feet. There was, therefore, a possible difference of 50 feet in diameters between stakes. By measurement, however, it was found that the largest diameter obtainable was 1,200 feet and the shortest 1,167 feet; an actual variation of 33 feet. The center used is 8 feet north of the median line of the trilobate mound. The figures placed upon the contour lines on the map, Pl. II, begin with 80 feet, as the lowest level in the trench, and extend to 104 feet, the highest point of the wall.

The High Bank Circle.

The High Bank circle, near Chillicothe, Ohio, was originally one of the finest specimens of its class extant. The embankment was inferior, apparently, in mass to that of the Observatory circle at Newark, but no part of it has escaped the plow, and the original height and profile cannot be ascertained.

The survey made by Mr. Gannett was intended only to determine the dimensions and approximation to a circle. It was not considered necessary to attempt to represent the relief, which is so slight and withal so uniform. The writer took the liberty, however, of sketching in contour lines of about one foot interval, the work being based upon profiles obtained by the hand level. The greatest height measured was 49 inches, and the mean of 32 observations of height made at nearly equal intervals about the circle is 30 inches. As roughly indicated upon the map, this circle does not occupy level ground, there being a descent of about seven feet from the main level toward the northeast. This descent is part of the face of a low terrace which extends from the river southeastwardly across the prairie.

The embankment is cut through in two places for a roadway, as indicated upon the map, and at one point, about 400 feet to the north of the gateway, there is a break or passageway of ancient date. By Squier and Davis and by Dr. Thomas this break is indicated as being absolute and abrupt, but this is not the case. The descent to the depression is so gentle as to be barely perceptible and the reduction is complete only on the inside. On the other side there is a rise of nearly a foot to the lowest part of the depression.

In making a series of sections across the embankment is was found that the mass was nearly twice as wide as indicated by Dr. Thomas' figures. It is evident that his measurements were in the nature of a compromise between what is and what was thought to have been. The ground having been freshly plowed and harrowed, we found it possible to determine somewhat closely the points at which the natural surface or profile changed to the artificial.

The following diameters, somewhat equally distributed about the crest line, may be given: 1,057, 1,062, 1,052, 1,055, 1,060, 1,060, 1,050, 1,045. The greatest variations of the 30 stakes set from a circle 1,057 feet in diameter is one 20 feet inside and another 10 feet outside, the former marking the decided eccentricity in the crest line 250 feet north of the gateway and the latter occurring at the north, where the wall is much flattened out and obscured. Of twenty stakes set on the best preserved part of the crest no one varied more than three feet from the circle drawn. The sum of the variations inside equalled the sum of those outside.

If the chain was used in laying out and regulating the construction of these three works the variations from exactness (66 feet) as indicated by our determinations would be as follows: 65.9 for the Observatory circle, a variation of $\frac{1}{650}$; 66.8 for the Fair Ground circle, a variation of $\frac{1}{880}$, and 65.06 for the High Bank circle, a variation of $\frac{1}{1056}$. These may well be regarded as extremely close approximations if the chain was used and remarkable coincidences if accidental.

Gunter's chain was first used about the year 1600 and would hardly have been employed in the Ohio valley until many years later. It should be noted that the circle determined in each case is the mean of a number of circles covering the full range of variation of the earthwork from that circle, and should not be thought of as necessarily representing any original circle laid out by the builders, since that circle may as readily have been upon the inner or outer margin as upon the center line of the proposed work.

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Mühlthal (Oberbayern). Verhandl. d. Berl. Gesellsch. f. Anthrop., 1891, 822–826.—**Newberry** (J. S.) The ancient civilizations of America. Pop. Sc. Month., N. Y., 1892, xli, 187–200.—**Niederle** (L.) Die neuentdeckten Gräber von Podbaba und der erste künstlich deformirte prähistorische Schädel aus Böhmen. Mitth. d. anthrop. Gesellsch. in Wien, 1892, n. F., xii, 1–18.—**Ornstein** (B.) Ueber einen wilden Menschen in Trikkala. Verhandl. d. Berl. Gesellsch. f. Anthrop., 1891, 817.—**Osborn** (H. F.) Present problems in evolution and heredity: the Cartwright lectures for 1892. Med. Rec., N. Y., 1892, xli, 197; 253; 449; 533.—**Ottolenghi** (S.) e **M. Carrara**. Il piede prensile in rapporto alla medecina legale e alla psichiatria. Gior. d. r. Accad. di med. di Torino, 1892, 3. s., xl, 423–434.—**Ottolenghi** (S.) & **L. Roncoroni**. Cento autopsie di criminali. *Ibid.*, 215–240.—**Owens** (J. G.) Natal ceremonies of the Hopi Indians. J. Am. Ethnol. & Archæol., Bost., 1892, ii, 163–175.—**Paris** (C.) Les ruines Tjames de la province de Quang-Nam (Tourane). Anthropologie, Par., 1892, iii, 137–144.—**Paulhan** (F.) La responsabilité. Rev. phil., Par., 1892, xxxiii, 385; 503.—**Penta** (P.) I germi del delirio nei condannati. Ann. di nevrol., Torino, 1891, n. s., ix, 369–389.—**Phillips** (H.) *Jr.* Second contribution to the study of folk-lore in Philadelphia and vicinity. Proc. Am. Phil. Soc., Phila., 1892, xxx, 246–249.—**Pisson** (G.) Races des hautes vallées du Tigre et de l'Euphrate. Rev. scient., Par., 1892, xlix, 581–588.—**Playfair** (W. S.) Sex in education. Brit. M. J., Lond., 1892, i, 1111.—**Rahon** (J.) Recherches sur ossements humains préhistoriques en vue de la reconstitution de la taille. Rev. mens. de l'École d'anthrop. de Par., 1892, ii, 234–237.—**Ranke** (J.) Ueber einige gesetzmassige Beziehungen zwischen Schädelgrund, Gehirn und Gesichtsschädel. Beitr. z. Anthrop. u. Urgesch. Bayerns, München, 1892, x, 1–140, 30 pl.—**Raymond** (P.) Le préhistorique le long de la rivière d'Ardèche. Bull. Soc. d'anthrop. de Par., 1892, 4. s., iii, 151–156.—**Regnault.** Le marriage aux Indes. *Ibid.*, 505–516. ——— Crânes d'Indiens du Bengale. *Ibid.*, 66–68. ——— La religion béguine. *Ibid.*, 1891, 4. s., ii, 785–792.—**Reinach** (S.) L'étain celtique. Anthropologie, Par., 1892, iii, 275–281.—**Rhys** (J.) & **T. W. E. Higgens.** First-foot in the British Isles. Folk-Lore, Lond., 1892, iii, 253–264.—**Richer** (P.) La physiologie musculaire par l'inspection du nu. Compt. rend. Soc. de biol., Par., 1892, 9. s., iv, 371–375.—**Roberts** (C.) Sex in education. Brit. M. J., Lond., 1892, i, 1112.—**Robinson** (L.) The meaning of a baby's foot-print. Nineteenth Cent., N. York [Lond.], xxxi, 795–806.—**Roth** (H. L.) Couvade. Rep. Brit. Ass. Adv. Sc., 1891, Lond., 1892, 800.—**Rubbens** (C.) Ancien cimetière et sarcophages découverts sur la commune de Linas, près de Montlhéry (Seine-et-Oise). Bull. Soc. d'anthrop., Par., 1891, 4. s., ii, 657–663.—**Sabatier** (A.) La synthèse des êtres vivants. Rev. scient., Par., 1892, l, 16–20.—**Saint-Loup** (R.) Les scolotes. *Ibid.*, xlix, 782–785.—**Saroli.** Della genesi del pensiero; soggio di psicologia fisiologica. Gior. med. d. r. esercito, etc., Roma, 1892, xl, 577–618.—**Schelihas** (P.) Die Göttergestalten der Maya-Handschriften. Ztschr. f. Ethnol., Berl., 1892. xxiv, 101–121.—**Schmid-Mounard.** Ueber den Einfluss des Militärdienstes der Väter auf die körperliche Entwickelung ihrer Nachkommenschaft, Verhandl. d. Versamml. d. Gesellsch. f. Kinderh. . . . deutsch. Naturf. u. Aerzte, 1891, Wiesb., 1892, ix, 55–79.—**Schneider** (O.) Der aegyptische Smaragd, nebst einer vergleichenden mineralogischen Untersuchung der Smaragde von Alexandrien, vom Gebel Sabara und vom Ural von A. Arzruni. Ztschr. f. Ethnol., Berl., 1892, xxiv, 41–91.—**Schumann.** Slavische Schädel vom Galgenberg und Silverberg bei Wollin (Pommern). Verhandl. d. Berl. Gesellsch. f. Anthrop., 1891, 704–708.—**Semitic** religions. [Rev.] Edinb. Rev., N. York [Lond.], 1892, clxxv, 325–341.—**Sibree** (J.) Divination among the Malagasy, together with native ideas as to fate and destiny. Folk-Lore, Lond., 1892, iii, 193–226.—**Sidgwick** (*Mme.* H.) Supplément au mémoire sur la clairvoyance. Ann.

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régime des eaux à l'époque de la pierre polée. Bull. Soc. d'anthrop., Par., 1891, 4. s., ii, 801–816.—**Wachholz** (L.) O przewrotnym popedzie plciowym. [Perversion of sexual instinct.] Przegl. lek., Krakow, 1892, xxxi, 357; 370.—**Walter.** Ueber das Gräberfeld auf dem Galgenberge und slavische Grabfunde bei Wollin. Verhandl. d. Berl. Gesellsch. f. Anthrop., Berl., 1891, xxiii, 708–717.—**Warner** (F. W.) Notes on Mexican archæology. Proc. Rochester Acad. Sc., 1889–91, i, 146–151, 1 pl.—**Weber** (F.) Bericht über neue vorgeschichtliche Funde in Bayern. Beitr. z. Anthrop. u. Urgesch. Bayerns, München, 1892, x, 133–140. —**Weigel** (M.) Bildwerke aus altslavischer Zeit. Arch. f. Anthrop., Brnschwg., 1892–3, xxi, 41–72.—**Welling** (J. C.) The law of torture: a study in the evolution of law. Am. Anthrop., Wash., 1892, v, 193–215. *Also, Repr.*—**White** (J.) A chapter from Maori mythology. Rep. Australas. Ass. Adv. Sc., Sydney, 1891, iii, 359–364.—**Wilson** (E. F.) Indian numerals. Science, N. York, 1892, xx, 9.—**Wray**, *Jr.* Ipoh poison of the Malay peninsula. [From: Kew Bull., No. 58.] J. Anthrop. Inst., Lond., 1891–2, xxi, 476–481.

Orientation of Mashonaland Temples.—In all the less ruinous temples of Mashonaland there is obvious evidence in the decoration on their exterior walls of orientation to either the rising or the setting sun at one of the solstices. The decoration on the great temple consists of a double band of chevron pattern, which extends along the part of wall directly opposed to the rays of the rising sun at the midsummer solstice. The time of the occurrence of the solstice was marked by means of a high monolith which would receive the shadow of another monolith placed on the wall at the middle of the decoration when the sun rose at the midsummer solstice. The great temple at first glance seems to be roughly elliptical, but when carefully measured its walls are found to be built on a number of circular curves of different radii. The great tower has a diameter at its base of 17.17 feet, and this length multiplied by the ratio of circumference to diameter (3.14) or by the square of this ratio gives either the radius or the diameter or half or double of these of the curves of all the wails of the best period which we have measured in Mashonaland.—*Swan in Scottish Geog. Mag., Sept., 1892, p. 485.*

BOOK NOTICES

The Speech of Monkeys. By R. L. Garner. In two Parts. New York: Charles L. Webster & Co., 1892. Sm. 8°. ($1.00.)

Dr. Garner has produced a book of singular interest. This interest arises partly from the subject and partly from the attractive style in which the author's observations and experiments are related. In the present notice the latter source of interest, fascinating as it is, may be passed over, and our attention chiefly directed to the more purely scientific results. The most important of these can be briefly told. The author finds that monkeys of every species which he has examined make certain vocal utterances which in his opinion can fairly come under the designation of speech. The number and variety of these sounds vary widely in the different species. Up to this time he has been able to determine, with a fair degree of certainty, nine "words" or specialized sounds uttered by the Capuchin monkeys, "some of which sounds are so inflected," he thinks, "as to have two or three different meanings." By "inflections" it is evident from the context that modulations of sound and not proper grammatical inflections are intended. The meaning ascribed to these sounds is in general very vague. Thus the sound which he at first rendered "food," seemed also to serve as a salutation or peace-making term. Another modulation of it expressed a wish to obtain a thing, and appeared to be almost equivalent to the verb "give," when used in the imperative mood. This sound he would represent in English orthography by "wh-oo-w." The "oo" is a pure vocal "u," like "oo" in "too." This vowel is preceded by a faint initial "wh," in which both elements are sounded, and the word ends with a vanishing "w." The phonetic effect, we are told, is rich and rather flute-like, and the word resembles somewhat the English "who." The word for "drink" he considers to be more fixed, both in its form and its meaning. To represent it he combines the German and French orthographies with the English. It "begins with a faint guttural 'ch,' glides through a sound resembling the French diphthong 'eu,' and ends with a slight 'y' sound, as in 'ye.'" There are three "alarm" sounds, one of which, having a shrill, piercing tone, very loud and very high in pitch and extremely terrify-

ing to the monkeys who hear it, cannot be expressed in letters. Another warning sound, which indicates less alarm, is represented by the dubious orthography "e-c-g-k," while a third, which merely draws attention to some approaching object, is a "guttural whisper," for which he adopts the spelling "chi," pronounced as in German.

Dr. Garner finds that every species of monkey has its own language, differing from that of every other species. A monkey of one species, confined with monkeys of another species, will, after a time, understand the meaning of the sounds which they utter, but can rarely be induced to repeat any of them. The monkeys of the new world are considered by him to be more intelligent than those of the old world; and the "Cebus" of Guiana, the genus to which the Capuchin (*Cebus capucinus*) belongs, is regarded by him as "the Caucasian of monkeys." It is probable that when he extends his researches to the great anthropoid apes, the gorilla, chimpanzee, orang, and gibbon, this opinion will be modified. One of the most notable of Broca's discoveries in physiology was that which found the seat of the faculty of language in a portion of the third or lowest of the three frontal convolutions of the human brain. This convolution is also found, though imperfectly developed, in the anthropoid apes, but not in the other quadrumana or in any other of the lower animals. In the only experiment which Dr. Garner was able to make with two chimpanzees in the Cincinnati collection, whose utterances he took down in the phonograph, he "was able to discern in a careful study of one cylinder as many as seven different phones, all of which come within the scope of the human vocal organs." There seems, therefore, good reason to expect that in the African trip which he contemplates making, with the view of continuing his investigations, and especially of studying the gorilla and chimpanzee side by side in their native wilds and recording the sounds they utter, he will be able to obtain many novel facts of great scientific value. Those who desire either to confirm or to confute the opinion expressed by Darwin, that a cry of alarm uttered by "some unusually wise ape-like animal" to warn his fellow-monkeys of expected danger was "the first step in the formation of a language," will await the result of Dr. Garner's further inquiries with much interest. The caution and good judgment which he has thus far displayed in his researches will give special weight to any facts which he may report, and the phonographic records will afford indubitable evidence of their truth. HORATIO HALE.

Nomina Geographica. Erklärung von 42,000 geographischen Namen, von Dr. J. J. Egli. Zweite Auflage. Leipzig, Brandstetter, 1892.

The first two numbers of this etymologic dictionary of local names, printed in double columns, are before us. The second edition will contain more than twice the number of names explained than does the first, and the author has been busy in extracting his vast stock of information from the best and most recent sources. Of the two elements which form each one of Egli's articles or items the descriptive one is very complete and satisfactory, so that the characteristics of every place, river, or land appear quite graphically from their physical and historical sides, whereas the etymologic part is at times very short. A large number of Egli's names are those given by discoverers, navigators and explorers, as *Alexandra Nile*, *Barthelemy Hills*, *Iles Beaupré*, *Buchholz Bay*, and are only of historic interest to us. The names of Asia and Africa are more fully represented in this useful publication than those of North and South America, though even of these there are a good number. Among the American topographic names spoken of may be mentioned Andoas, Punta Anegada, Marañon, Aimorès (another name for the Botocudo Indians), Adirondacks, Atchafalaya, Mar Bermejo, Bodega Bay, Ancasmayu, and Acapulco. A. S. GATSCHET.

Ethnology in Folklore. By George Laurence Gomme. New York: D. Appleton & Co., 1892, 204 pp. 12°. ($1.00.)

The record of the past history of our race is written in things, the study of which is called archeology; or in inscriptions, whose decipherment is called paleography; or in the languages of mankind, explained by the principles of comparative philology; or, finally, in the lore and custom of the unlettered, for the scientific study of which no name has been invented. Both the body of phenomena and their scientific treatment are termed Folklore.

Before archeologists, were archeographers and collectors of materials, and before the logical period of folklore has been the graphic period. But now many of the distinguished explorers and collectors have turned philosophers, reckoning how these things came to be so and what they mean. Among the foremost in this field occupied by our English friends stands Mr. G. Laurence Gomme, whose volume is now before us.

The argument of the author brings out clearly the difference of

environment between English folklorists and their American colleagues. Those of us who have lived in the South and have seen Indians telling stories to negroes, which the latter repeat to our children, will wonder why Mr. Gomme finds it so difficult to impress upon his countrymen that differences in lore are evidences of difference in race. On the other hand, his book is an argument and a protest against the proposition that the lore of our ignorant folk is only the survival of the lore of their ancestors.

Now, in our ethnologic work we have had trouble with the "double corner" of survival and what Major Powell calls acculturation. For instance, our

> "Rock-a-by baby on a tree top,
> When the wind blows the cradle will rock,
> When the bough bends the cradle will fall,
> And down will come cradle and baby and all"

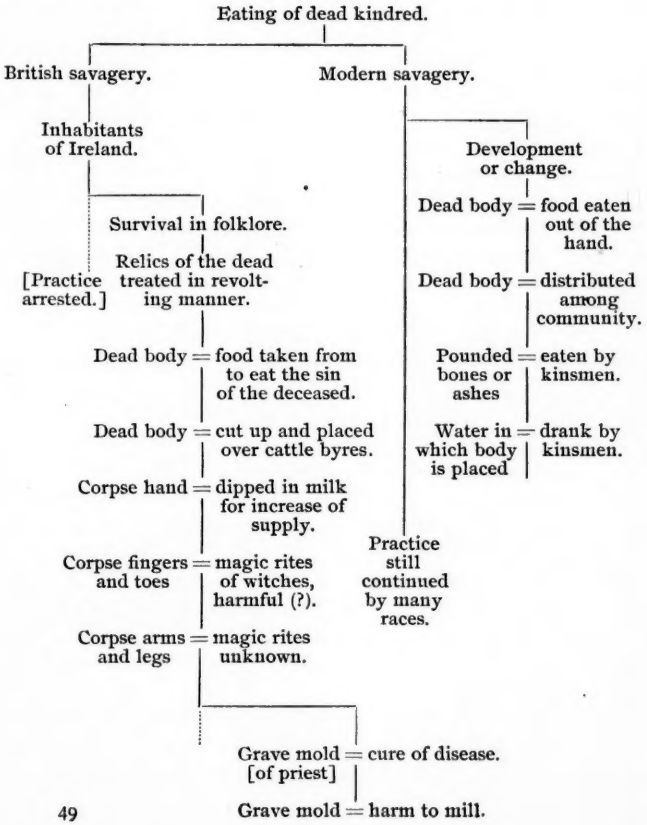
is not fitted to our cradles, but it harmonizes exactly with the Indian cradle, suspended from a knot on a limb of a tree and dropped to the ground by a brisk wind. But the Indian did not compose or write it, even if it should turn out to have been suggested by his cradle and carriage in one. Again, the rhyme—

> "By O baby bunting,
> Papa's gone a hunting,
> To buy a robe of rabbit skin
> To wrap his baby bunting in"

fits exactly to the robes of rabbit skins cut into long strips and woven closely with the hair on, making a baby wrapper about six feet by three square and quite an inch thick, warm enough for any baby bunting. From these tiny sketches it may be seen how the lore and the custom of savagery not only get recognized by the civilized, but the latter help the process in a thousand ways.

Mr. Gomme insists that the reading backward of much that seems useless in the speech of our untutored folk will not only point out the routes along which culture has traveled, but will also take us to the people who have made this or that contribution. The term "uncivilization" is employed by the author to denote the non-progressive, backward element in society, and in the same connection he holds that the chief source of improvement among the peoples of the earth has been the influence of foreign action. The assertion that there is no evidence of the introduction of uncivilized culture into countries already in possession of a higher culture is too

sweeping. Every white child that ever grew up in Virginia knows better, having had his youthful imagination crowded with fancies and peopled with lore furnished by "ole mammy" and "uncle Tom," just as soon as he could crawl about. At this moment I remember Judge Burke waiting two hours so as to have me ride behind him past the Pincushion stone, a huge bowlder whereon sat an old negro woman, who stuck pins in white folks after dark. The "Festival of the village goddess" is nicely worked out by Mr. Gomme, and its elements traced among Aryan peoples everywhere. The family tree of cannibalism is repeated to show the succinct manner in which our material may be worked out.


Eating of dead kindred.
British savagery.
Modern savagery.
Inhabitants of Ireland.
Development or change.
Survival in folklore.
Dead body = food eaten out of the hand.
Relics of the dead treated in revolting manner.
[Practice arrested.]
Dead body = distributed among community.
Dead body = food taken from to eat the sin of the deceased.
Pounded bones or ashes = eaten by kinsmen.
Dead body = cut up and placed over cattle byres.
Water in which body is placed = drank by kinsmen.
Corpse hand = dipped in milk for increase of supply.
Practice still continued by many races.
Corpse fingers and toes = magic rites of witches, harmful (?).
Corpse arms and legs = magic rites unknown.
Grave mold [of priest] = cure of disease.
Grave mold = harm to mill.

If there is a fault in the book, it is holding too strongly to the conviction that peoples do not develop along the lines of their own inventions. Borrowing must stop somewhere. This must not be taken as an adverse criticism, for we have naught but praise both for writer and book. O. T. MASON.

Primitive Man in Ohio. By Warren K. Moorehead. New York: G. P. Putnam's Sons, 1892, pp. xv–246. 8°. ($3.00.)

Every publication which presents additional reliable data in reference to the antiquities of our country is a welcome contribution to the rapidly increasing mass of archeological literature; and this is true, regardless of the form or style in which it is presented. As the ancient monuments of our country are being rapidly obliterated by the remodeling hand of advancing civilization, each fact regarding them which is put on record in a reliable form is thereby preserved to future students. According to the preface of the above-named volume, the "number of mounds, graves, and cemeteries opened during the four seasons of exploration was one hundred and seven." As these appear to be accurately and faithfully described with a comparative freedom from bias toward a particular theory, the work must take its place among the permanent literature of the subject.

Although nothing absolutely new in regard to the primitive arts or customs, except two or three copper articles, appears to have been discovered, valuable additional data respecting the mounds and ancient graves of central and southern Ohio were obtained, which will assist in settling mooted points. The discovery of numerous box-shaped stone graves in the valley of the Little Miami is of special interest, as the presence of these cists indicates a relationship of the former inhabitants of this section with the mound-builders of middle Tennessee. If it should ultimately be admitted that the Shawnees were the chief constructors of the graves of this form, it will also tend to strengthen the belief of several writers that this tribe or a part of it occupied a portion of southern Ohio in prehistoric times.

Notwithstanding the strong influence which the craniological theory evidently has on the mind of the author of the descriptive portion of the volume (for it appears to be a joint production), his

enthusiasm for his work has led him to follow his eyes in his descriptions rather than theory. However, in stating his conclusions (chapter XVI) it is carried somewhat to an extreme when he remarks, "We would say that the presence of dolicocephalic skulls at Hopewell's Earthwork, Fort Ancient, or at Madisonville indicates the adoption and gradual absorption of the former people captured by the short-head stock. It is possible that the crania of the long-headed type which we found near the short-heads were those of slaves, placed thus to indicate their vassalage." Yet in the immediately following paragraph he places the mound-builders of Ohio in precisely the culture-status of the more advanced Indian tribes of the Mississippi valley when first discovered by the whites.

The author appears to be a staunch advocate of Squier and Davis, severely criticising those who are disposed to cast doubts on any part of the work of these authors. The reason, however, which he gives for his implicit faith is somewhat singular. "We know," he remarks, "from excavations and our own surveys, that in the truthfulness of their reports they frequently have been overcautious and moderate in their enumerations of finds in order to keep entirely within the bounds of truth." As it is somewhat difficult to understand how Mr. Moorehead could "know" from his "excavations" and "surveys" the number of articles found by these authors, we must presume he intends to allude to their statements as to the mounds they opened and what they did. No one, so far as I am aware, has expressed any doubt in regard to these. The doubts which have been expressed relate to the correctness of their surveys and their conclusions. Mr. Moorehead also asserts his unwillingness "to give countenance to their conclusions," and his belief that much of their work was "hastily projected." His criticism therefore applies as well to himself as to others.

The evident disposition of the young explorer to assume the tone and authority in his language of the veteran archeologist somewhat mars his work. Such expressions as the following had better been omitted: "It is the purpose of our book to do away with certain of these illusions." "We are therefore quite confident that our material, so carefully collected and thoughtfully weighed [?], will not be cast aside and its place usurped by the rash statements of hasty and incompetent investigators." "Why there should be so much speculation and uncertainty concerning the life of our aborigines is inexplicable to us." It is very questionable, however, whether the work

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he puts forth, notwithstanding its value as a contribution to archeological literature, will do away with these doubts.

Although the volume is edited and chiefly written by Mr. Moorehead, chapter I, "Paleolithic Man in Ohio," and chapter XVII, "Crania and Skeletons," are contributed by Dr. H. T. Cresson; chapter III, on the Muskingum Valley, by Mr. W. H. Davis, and chapter IV, on Flint Ridge, by Mr. Gerard Fowke.

The publishers have presented the book in an attractive form, the only defect being in the illustrations. The cuts, except where taken from photographs, are deficient in those details necessary for study and comparison. This we presume is due to the artist rather than to the publishers.

CYRUS THOMAS.

The Language of the Mississaga Indians of Skūgog. A Contribution to the Linguistics of the Algonkian Tribes of Canada. By Alexander Francis Chamberlain, M. A. Philadelphia, 1892, pp. 1–84. 8°.

The Mississaga are an Algonquian tribe settled in different localities within the province of Ontario, as at Alnwick, Rice lake, etc., and are closely affiliated in race and language to the Nipissing and Ojibwē Indians. They are noticed as distinct from these as early as 1648. A portion of them settled in 1844 on Skūgog island, in the lake of the same name, opposite Port Perry, Ontario county, and in 1884 the tribe numbered forty-three persons. Professor Chamberlain has made a special study of these Indians and has given the results in eight treatises, the one before us containing a revised and comprehensive embodiment of some of his researches, including a large amount of special information on the Skūgog dialect, supported by numerous references to the cognate Algonquian languages.

The differences between Skūgog and Nipissing-Ojibwē are much more of a lexical than of a morphologic character, and whatsoever the author could notice concerning difference in pronunciation refers mainly to some vowels. He had the good taste not to syllabicate the Indian words, and it is fervently to be hoped that the latter mode of notation, like the use of Roman letters with their English value, may soon be entirely abandoned in the fixation of Indian words, texts, and songs.

The words quoted by Professor Chamberlain are all properly accented and, when necessary, provided with marks of length and

brevity. The etymology of Skūgog words, wherever it can be given with safety, is mentioned in the vocabulary (pp. 24–52), as well as in the subsequent sections, and in the vocabulary the English definition stands first. The real signification of words and of proper names of men, women, tribes, plants, animals, mythologic, and other characters is made apparent throughout from their origin, a painstaking work which involves, to be done with accuracy, a great amount of study. As to the compounding of words, the author states the three following to be the chief modes of composition: juxtaposition of words, complicated agglutination, and "word-decapitation" (p. 17). Here, as well as in all Indian dialects, a large number of radical suffixes and affixes are found to exist which have no independent existence in the language as separate words, but take the place of the real words in composition.

The author was fortunate enough to secure a few mythologic texts, fragmentary and complete, some in the Indian, others in the English language. There are also a few war, hunting, and love songs, with English or French translation. The volume concludes with a useful comparative table, in which fifty-five terms of Mississaga are placed opposite corresponding words in Nipissing, Ojibwē of Lake Superior, Cree, Blackfoot, Lenápe or Delaware, Micmac and Massachusetts, and to this is appended a bibliography of the Mississaga language.

It is evident that the author had no intention of composing a full grammatic sketch of the language studied, for he leaves us uninformed as to the polymorphous inflection of the verb (better called "adjective verbified") or the animate and inanimate order of substantives recognizable chiefly through their suffixes in the plural, or the classifying terms added to the numerals or the distributive form of the numeral as formed by reduplication. His book may be called "a selection of notes concerning the Mississaga dialect of Skūgog Island," and regarded as such it is an essay worth perusal indeed.

The real import of Wemitigūshi, the Algonquian term for Frenchman, is not well understood. Professor Chamberlain obtained the suggestive explanation of "carrying a trunk," referring to the French traders of early colonial times, while others have discovered in the "hollow" (*wash*) "wood" (*mitīg*) the wooden ships in which the French reached the coasts of Canada, or which they constructed upon the Canadian rivers and lakes.

As for the name of the Ojibwē tribe of Indians, Chamberlain approves none of the etymologies presented heretofore; but in our opinion there can be no doubt that it means "they are puckered," for even now this tribe is in the habit of wearing *moccasins with leather puckered at the instep.* Their women who manufactured them have been careful to transmit in this manner to posterity a custom which is probably over a thousand years old.

A. S. GATSCHET.

Language as a Test of Mental Capacity, Being an Attempt to Demonstrate the True Basis of Anthropology. By Horatio Hale, M. A. (Transactions of the Royal Society of Canada. Vol. IX, Sec. II, 1891, pp. 77–112. 4°.)

This elaborate treatise deals with a number of facts and problems occurring in the study of various languages of the globe, and the deductive line of argument used by the author makes it rather difficult to give an abstract of its subject-matter. He holds that the languages of America and those of Polynesia are at the very opposite poles in their lexical and grammatical characteristics, and while the former represent cumulative agglutination, the others are typical of a far-advanced analytic structure. "Not simplicity, but complexity (p. 105) is the evidence alike of progress and of the energies which lead to progress—the simplest forms of animal life are the lowest. The complexity of the American and Australian languages is the evidence not of poverty of the powers of abstraction and analysis, but of the very reverse." Mr. Hale believes in the existence of a radical and structural connection between the Dravidian and the Australian languages, and thinks the Australian continent was peopled by that East Indian race. There is something to be said in favor of this theory, but nevertheless that migration is hypothetical only, for it is only based on the similarity of some of the pronouns. The author shares the opinion of Duponceau, that culture, science, and literature stand for something, but for little only in the *formation* (not in the development) of language. The reader is referred to the article itself for a full and exhaustive estimate of the ideas it contains.

A. S. GATSCHET.

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